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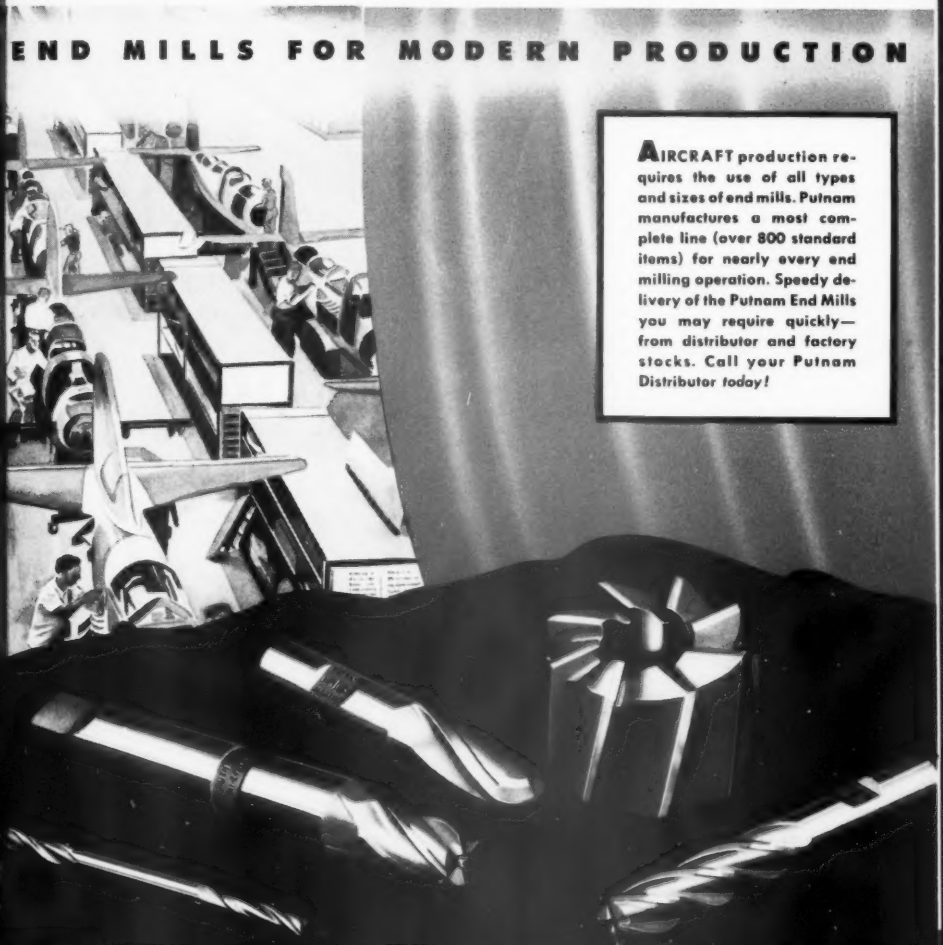
TOOL & DIE JOURNAL

DESIGN, MANUFACTURE AND USE OF PRODUCTION TOOLING

END MILLS FOR MODERN PRODUCTION



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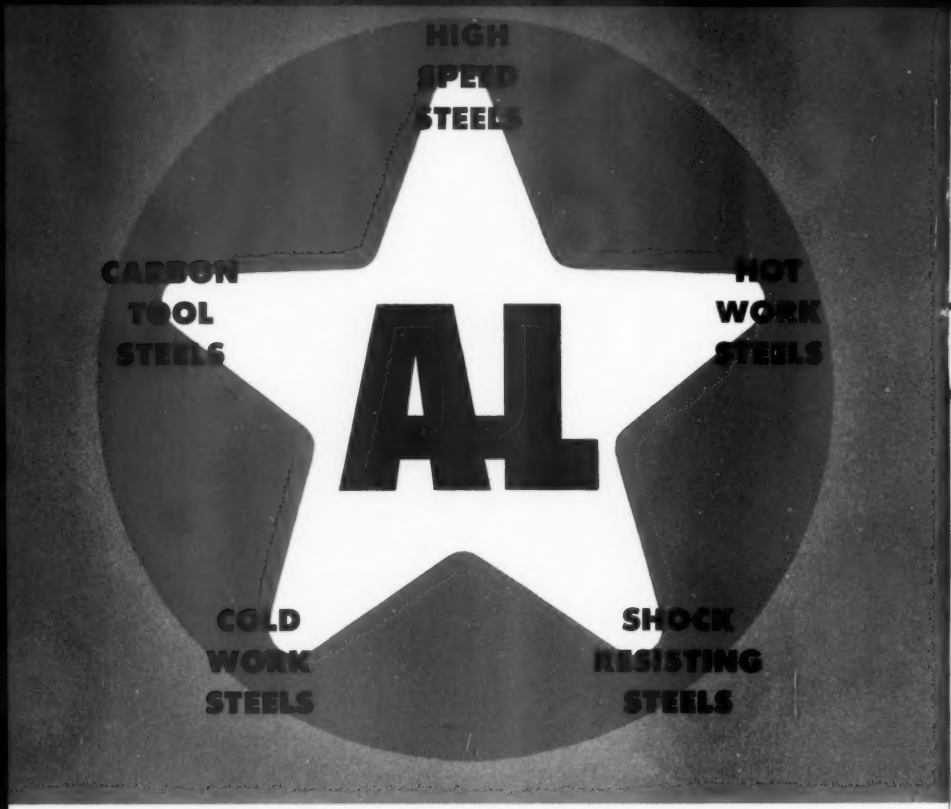

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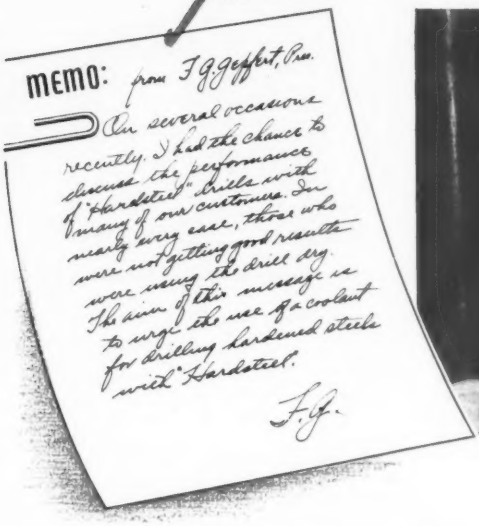
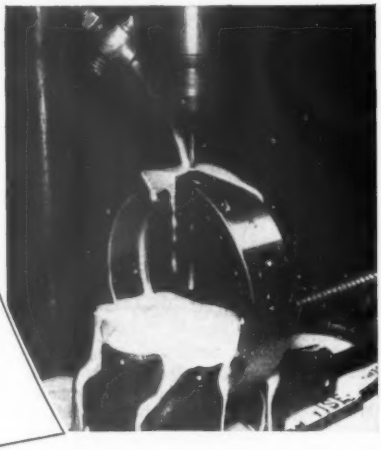

MEMO: from F.G.Gefffert, Pres.
On several occasions recently, I had the chance to discuss the performance of "Hardsteel" drills with many of our customers. In nearly every case, those who were not getting good results were using the drill dry. The aim of this message is to urge the use of a coolant for drilling hardened steels with "Hardsteel".
F.G.



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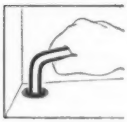

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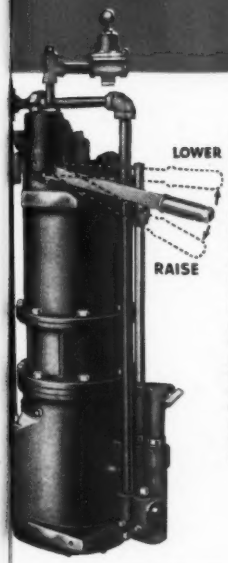

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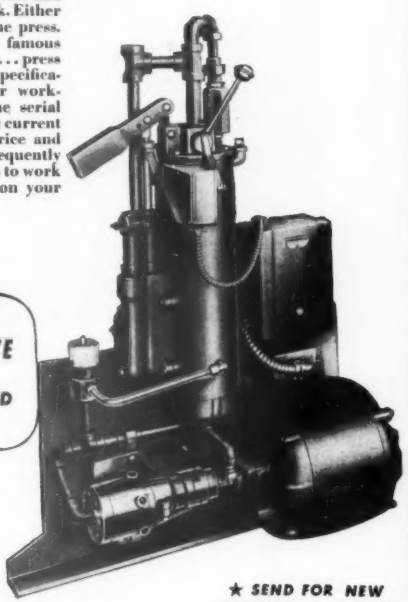

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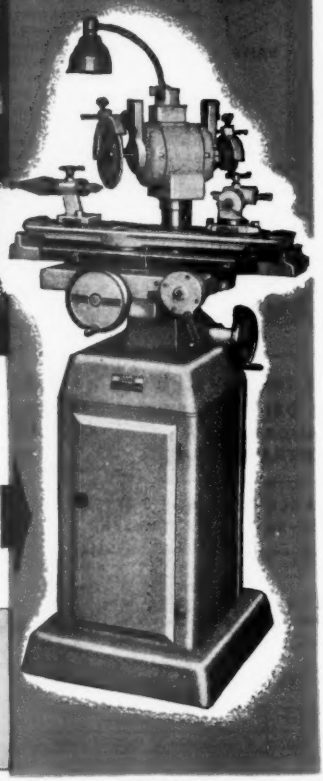

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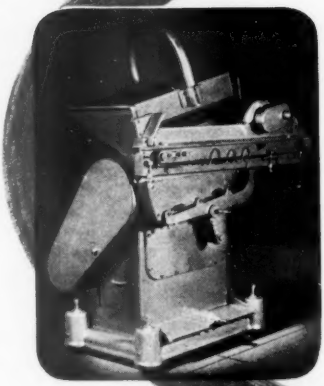
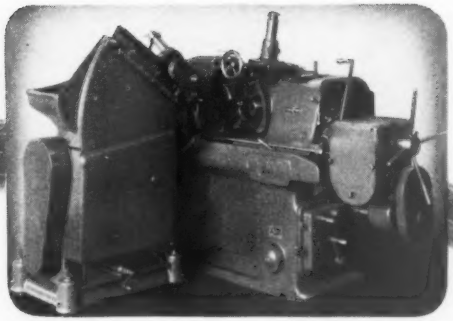


Type E Feedmatic [illegible] long runs of thrufeed [illegible] nates manual feeding oper[illegible] One man can operate several machines equipped with hoppers.

CINCINNATI



Type B Feedmatic Hopper, designed for long runs of infeed work. Shown on the right of the machine is the Automatic Infeed Attachment.

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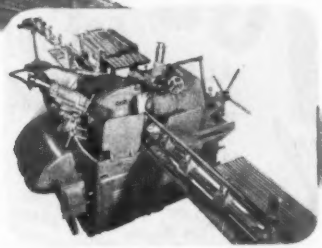
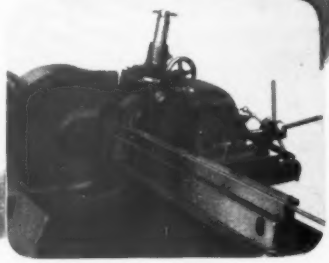


Type C Long Bar Attachment for grinding bars ½" to 2" in diameter and lengths up to 18 feet.

Type A Long Bar Attachment for grinding bars ⅛" to 1¼" in diameter and lengths up to 2½ feet.

Cincinnati Feedmatic No. 2 Centerless Grinding Machine. Complete information is contained in catalog G-456-4.



Type B Long Bar Attachment for grinding bars ⅛" to 1¼" in diameter and lengths up to 8 feet.

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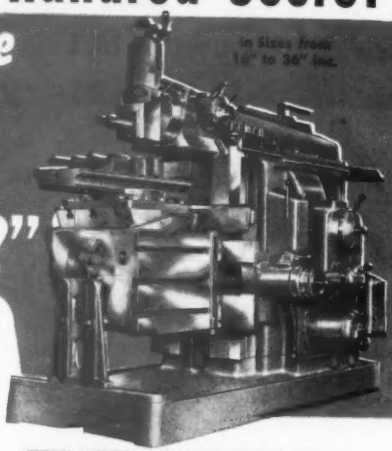

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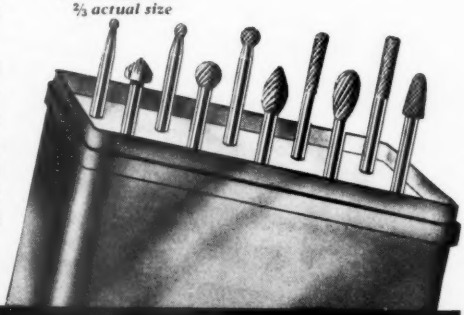

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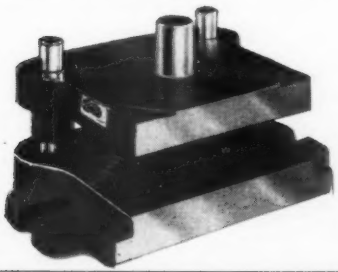

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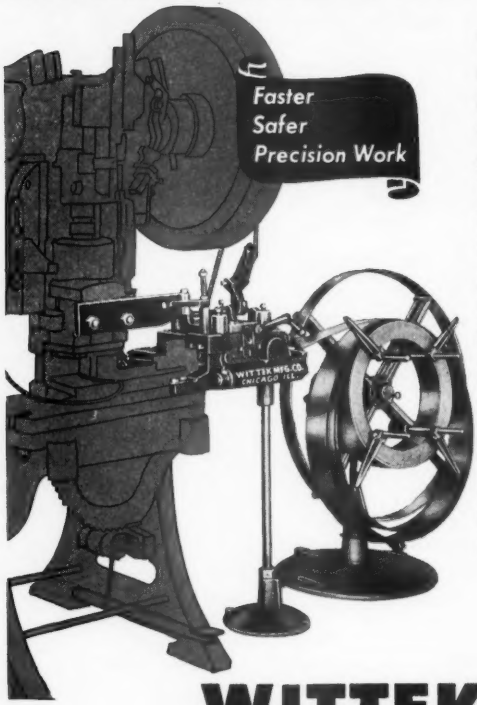

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- ☐ Bulletin No. 1400; Super-Speed Vertical Milling Machines.
- ☐ Bulletin No. 1800; Precision Automatic (Swiss-Type) Screw Machines.
- ☐ Bulletin No. 1635; Tracer-Controlled Electric Arc Etchers.
- ☐ Bulletin No. 1317; Accessories and Cutter Grinders.
- ☐ Bulletin No. 1309; Master Copy Type for all Pantograph Machines.
- ☐ Bulletin No. 1833; Handbook for Automatic (Swiss-Type) Screw Machines. Price $2.50.
- ☐ Bulletin No.1655 is the Condensed Catalog of all Gorton Machines; it will help you decide if Gorton can be of service to you. Includes list of Gorton dealers.

GEORGE GORTON MACHINE CO.
Tracer Controlled Milling
1201 RACINE STREET • RACINE, WISCONSIN, U.S.A.

Are You, *too*, Paying

Production costs are not necessarily determined by the initial outlay for tools but rather by **unit cost** of parts produced.

At a recent conference of the National Tool & Die Association, the President mentioned one specific instance of saving in the production of an airplane part.

The outlay for tools was increased from $600 to $15,000 with the result that the cost per part dropped from $7.50 to $1.15. Since 250,000 units were made, the saving on this operation alone was more than $1,500,000.

This instance is typical of results attained here at McKinney. In fact, we regard as the sole reason for existence our ability to improve production methods and lower costs through improved tooling.

Being in a different position from that of any one manufacturer, we get a broad general view and are able to bring to each problem up-to-the-minute workable knowledge of most modern equipment, processing methods, etc., to the end that the most efficient results are attained.

Competent Planning

Competent Execution

the *High Cost* of Low Priced Tooling?

McKinney service is playing and will continue to play an ever increasing part in offsetting constantly increasing material and labor costs and assuring profits despite these difficulties.

We thrive on difficulties. Why not "toss yours in our lap"?

By way of introduction, why not write for this six page colored bulletin illustrating and describing highlights of McKinney equipment, plant facilities and personnel experience?

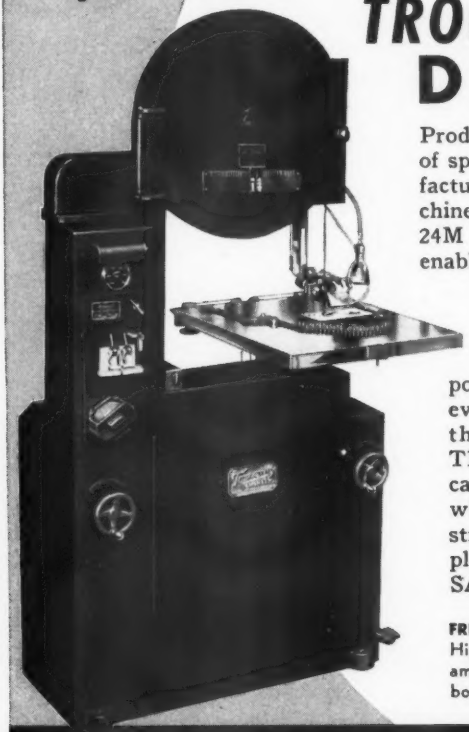
Or better yet, let us send a McKinney representative to explain the highly specialized nature of our service and how it can aid in solving your tooling problems.

If you have something in preliminary sketch or blueprint form, mail it in for prompt study and recommendation. No obligation will be entailed.

McKINNEY TOOL & MFG. CO.
CLEVELAND
DESIGNERS and BUILDERS of PRECISION TOOLING
Since 1920
1673 Arabella Road
Tools-Dies-Jigs-Fixtures-Special Machinery

Tannewitz

The RUGGED-TROUBLE-FREE DI-SAW



Product of more than 50 years of specialization in the manufacture of band sawing machinery the TANNEWITZ 24M is the machine that will enable you to capitalize to the fullest extent on the economies of contour sawing, inside and outside filing and polishing. It's rugged, with every detail of construction thoroughly proved, — TROUBLE-FREE. And it carries full 24-inch wheels which make for easier, straighter sawing. For complete details write for DI-SAW Bulletin.

FRICTION SAWING with Tannewitz High Speed Band Saws offers many amazing advantages. Write for free booklet.

THE TANNEWITZ WORKS
GRAND RAPIDS 4, MICHIGAN

8 Quick Moves
TO LOWER MILLING COSTS

Jump at the opportunity to reduce your milling costs by utilizing Kempsmith standard attachments. These precision-built tools make it possible for you to convert your standard milling machine into a special purpose miller, thereby reducing costs to rock bottom. Kempsmith Attachments, Arbors and Accessories have long proven their ability to handle both delicate tool room jobs and fast production runs. They have the same high degree of precision workmanship and accuracy characteristic of Kempsmith machines for more than 57 years. It will pay you to investigate.

Let an experienced Kempsmith Engineer show you how to apply Kempsmith Standard Attachments to your milling jobs. There's no obligation and it may lead to substantial savings in costs. Write for literature

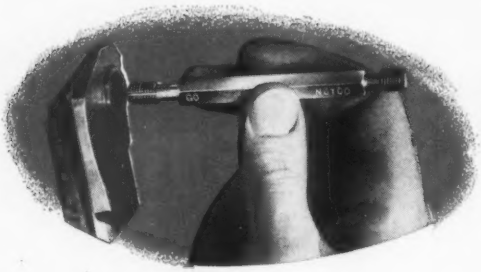
THE KEMPSMITH MACHINE COMPANY, MILWAUKEE 14, WIS., U. S. A.

KEMPSMITH *Attachments and Arbors!*

Precision Built Milling Machines Since 1888

A 5076-1P

Are you one of the 69.1%?



Graph-Mo Steel can help you meet today's demands for closer tolerances

"WE are planning to work to closer tolerances than before the war." That's what 69.1% of the plants reported in a recent survey by Steel Magazine.

If you are one of this group, be sure *your* gages are made of Timken Graph-Mo steel. The presence of free graphite in its structure, in combination with uniformly dispersed, diamond-hard carbides, gives Graph-Mo the properties necessary for outstanding gage performance.

Graph-Mo steel has remarkable machinability. It offers stubborn resistance to wear. It has extreme structural stability. No wonder Graph-Mo steel gages have achieved such a superior record of accuracy and long service!

So meet today's demands for closer tolerances with gages of Graph-Mo steel. And if you'd like to know more about Graph-Mo, send for our free 48-page booklet, filled with valuable information and illustrations on the use of Graph-Mo and the other famous Timken graphitic steels. Just address a request on your firm's letterhead to Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing.

CUSTOM-BUILT TO THE MOST *Exacting Specifications*

G·S SMALL GEARS are cut to extremely close tolerances. Each specification, however exacting, is executed and inspected with a degree of precision seldom equalled in small gear manufacture. Here, every facility has been provided for speedy, uniform quantity production: 1. Skilled engineers and designers; 2. Modern methods and machinery; 3. Trained operators; 4. Intensive series of inspections; 5. All operations under the constant supervision of *specialists*—men long experienced in producing Fractional Horsepower Gears exclusively. That's why G. S. Gears perform so smoothly and dependably for years, and that's why *each* G. S. Gear measures up to the same, exacting specifications. If Small Gears, from 12 to 96 d.p., are an important consideration in YOUR plans, for your own best interests, let our organization of specialists tackle the job! Consult with our engineers, or write today for a copy of the new G. S. catalog bulletin.

SEND FOR OUR 4-PAGE CATALOG

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MEMBER OF AGMA

2635 WEST MEDILL AVENUE • CHICAGO 47, ILLINOIS

WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARS

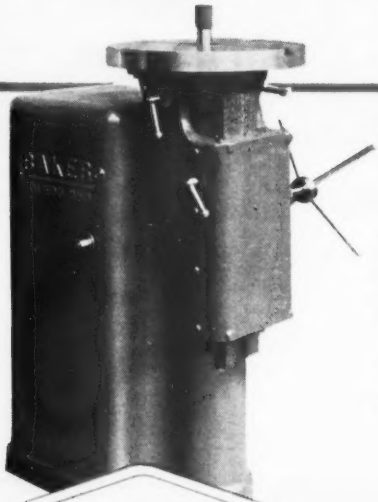
ACCURATE, COST-SAVING PERFORMANCE

on Work like this . . .

FLAT CAM

DIE

LEVER



Contour Grinding is *rapid, economical* and *accurate* . . . with this Baker Model No. 3 Grinder. Performs hand grinding which other types of grinders won't readily handle. Has vertical reciprocating movement of spindle—3/16". Diamond dresser is standard equipment and is quickly mounted.

Capacity, diameter of wheels—½" to 4". Capacity, face of wheels—2"-2½"-3". Diameter of table 18". Write for illustrated circular.

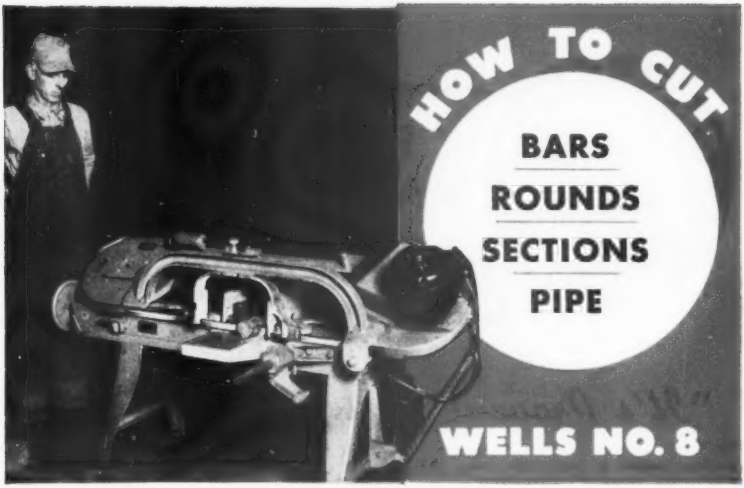
BAKER

MODEL 3

CONTOUR GRINDER

BAKER BROS., *Inc., Toledo, Ohio*

DRILLING, BORING, TAPPING and KEYSEATING MACHINES



METAL CUTTING BAND SAW

specifications

CAPACITY:
Rectangular . . . . 8" x 16"
(Special Guides) . . 5" x 24"
ROUNDS: . . . . 8" diameter
MOTOR: . . ½ H.P., A.C. or D.C.
SPEEDS: Selective
60, 90, 130 feet per minute
WEIGHT: Approximately 665 lbs.

If you have a variety of metal cutting jobs — bars, rounds, sections, pipe, tubes — it will pay you to investigate the advantages offered by portable, practical Wells saws. Simple in design and rugged in construction, the Wells No. 8 requires no highly skilled operator or special handling. Powerful, quick-acting vise reduces set-up time to a minimum. Gravity feed and automatic shut-off make it practical for one man to operate two or more Wells saws simultaneously. For production work, your Wells can be equipped with the new Wells Wet Cutting System for faster cutting and longer blade life. Ask for the complete story. Literature and quotations on request.

Wells SAWS

Wells

Products by Wells are Practical

METAL CUTTING BAND SAWS

WELLS MANUFACTURING CORPORATION
1940 ASH STREET, THREE RIVERS, MICH.

PRECISION
REID
SURFACE GRINDERS

PRECISION MANUFACTURING
For 46 YEARS is Your Assurance

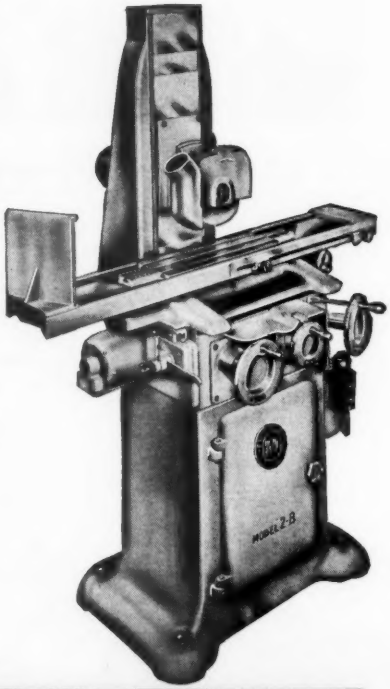
"It's Proven!"

The "Know How" experience gained over this long period is built into every REID PRECISION SURFACE GRINDER.

BECAUSE OF

**DEPENDABLE ACCURACY,
ECONOMICAL PRODUCTION,
CONTROLS AT YOUR FINGERTIPS,**

**LEADING SHOP MEN EVERYWHERE SAY,
*"for Close Tolerance, use a Reid!"***



**Illustrated is the REID Model 2-B
All-Electric Power-Feed.**

The Reid Model 2-C Hand-Feed also is an exceptional machine for tool, gage, die and certain production grinding.

MACHINES EQUIPPED FOR WET GRINDING IF NECESSARY.

EXCELLENT DELIVERIES

Distributors conveniently located in all sections

**WRITE DEPT. F
For Illustrated Bulletin and Prices.**

REID BROTHERS COMPANY, INC.
BEVERLY MASSACHUSETTS

Now-a new die steel

FOR DIE CASTING WHITE METAL ALLOYS
AND FOR PLASTIC MOLDS

free machining

EVEN AT 275-300 BRINELL

Speed-Cut

FIRST IN QUALITY

FIRST IN PERFORMANCE

Speed-Cut machines as readily at 275-300 Brinell as ordinary die steels that have been fully annealed. Furnished in the heat treated condition, Speed-Cut saves you money by eliminating treating and polishing costs. Also available annealed.

Get all the facts about this new steel. Write for descriptive bulletin just off press!

Vanadium-Alloys Steel Company

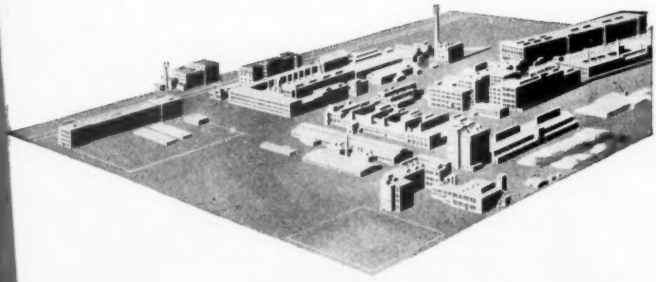
LATROBE, PA.

COLONIAL STEEL DIVISION—ANCHOR DRAWN STEEL COMPANY

A BUYING GUIDE FOR ABRASIVES

POINT No. 1

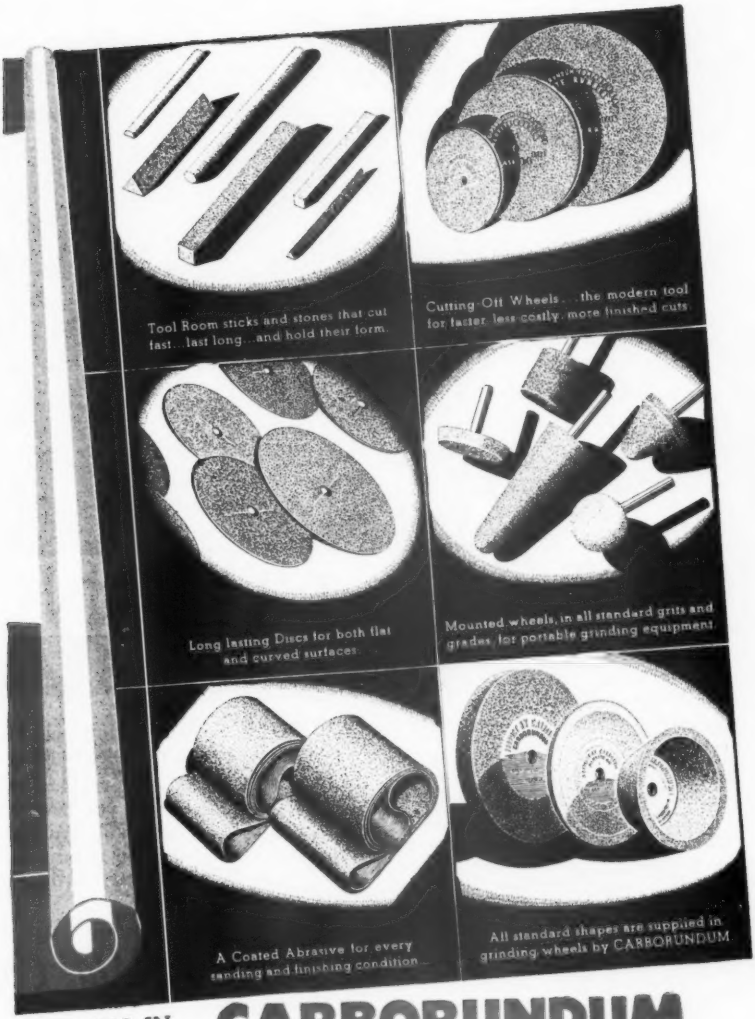
MANUFACTURING RESOURCES



It is understandable to anyone in Production that better manufacturing resources generally lead to a superior product. Quality is not to be had for the mere wishing. The vast manufacturing facilities of The Carborundum Company are known to be an important part of the nation's industrial picture, and are pointed to as being in the forefront of manufacturing and technical progress. Not the least of the reasons for the satisfying, uniform, and dependable quality of Abrasives by CARBORUNDUM are the spacious, modern, alert and efficient manufacturing facilities which produce those abrasives. The Carborundum Company, Niagara Falls, N. Y.

"CARBORUNDUM" IS A REGISTERED TRADEMARK WHICH INDICATES MANUFACTURE BY THE CARBORUNDUM COMPANY

A Good Rule for Good Grinding


Tool Room sticks and stones that cut fast...last long...and hold their form.
Cutting-Off Wheels...the modern tool for faster, less costly, more finished cuts.
Long lasting Discs for both flat and curved surfaces.
Mounted wheels, in all standard grits and grades, for portable grinding equipment.
A Coated Abrasive for every sanding and finishing condition.
All standard shapes are supplied in grinding wheels by CARBORUNDUM.

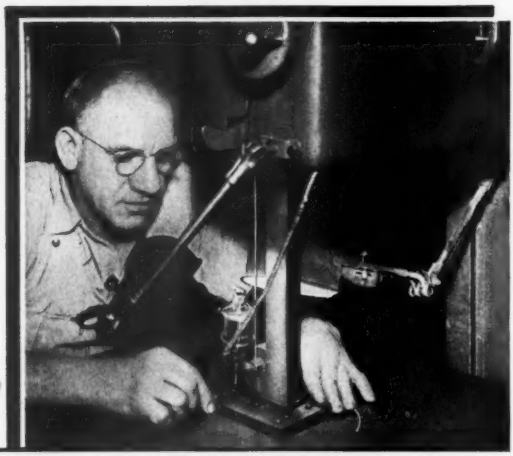
... CALL IN **CARBORUNDUM** TRADE MARK

● BONDED ABRASIVES ● COATED ABRASIVES ● ABRASIVE GRAINS AND COMPOUNDS

Specify ATLANTIC

BAND SAW BLADES

for Smoother



CONTOUR CUTTING

ATLANTIC SAWS meet all of your requirements for a superior blade on complicated die and fixture radius cutting. ATLANTIC specializes in accurate milled and precision set teeth, hardened to exact temper.

Atlantic's strong, practical box, plainly marked on sides and top. Remains in good condition until entire coil is used.

ATLANTIC'S special alloy steel insures longer wear and easier welding.

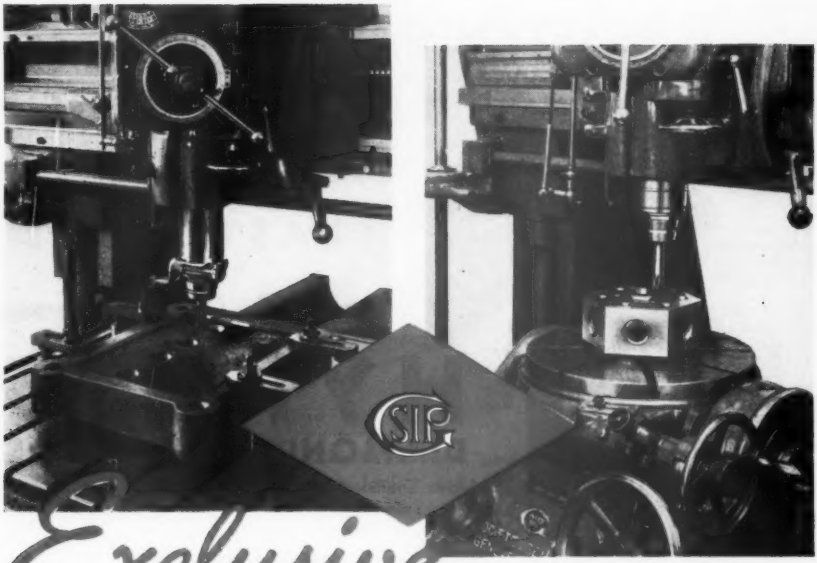
ATLANTIC'S one temper saw for all metals reduces stock you have to carry. Cut to length and welded, ready for use. Packed in strong Atlantic box. Write for new Atlantic Catalog.

Atlantic Saw Mfg. Co.

INCORPORATED

Exclusively Manufacturers of Band Saw Blades

160 Brewery St., New Haven, Conn.

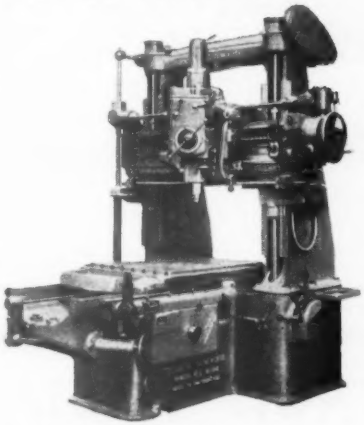


Exclusive

. . . PRECISION *and* VERSATILITY!

These two precision operations illustrate the extensive range of applications of the SIP HYDROPTIC-B made possible by its exclusive adaptability for milling as well as jig boring and drilling. On the base plate for a piercing die, the milling as well as all the boring operations are performed by the HYDROPTIC-B Jig Boring and Milling Machine. On the second job, all six sides as well as the top surface of the turret head are machined in a single set-up, using the HYDROPTIC-B equipped with the SIP tiltable indexing table.

Combining hydraulic feeds for versatility and optical settings for the highest precision, the SIP HYDROPTIC-B Jig Boring and Milling Machine will answer your most exacting needs for toolroom and production operations.



SIP JIG BORERS
RANGE OF TABLE SIZES

No. 2C	18″ x 10¾″
No. 2H	27½″ x 12½″
No. 3K	20½″ x 15″
No. 4G	27½″ x 23⅝″
Hydroptic B (illustrated)	39½″ x 32″

HIGH PRECISION MACHINE TOOLS AND MEASURING INSTRUMENTS

COSA CORPORATION

COSA

CHRYSLER BUILDING
New York 17, New York

LAPPING AND POLISHING

TUNGSTEN-CARBIDE and STEEL

DIES AND PUNCHES
GAGES AND TOOLS
PLASTIC MOLDS

with

Applicator Gun With Sealed Cartridge Unit for Quick Refill. Dust Proof. Full Control.

HYPREZ
DIAMOND COMPOUNDS

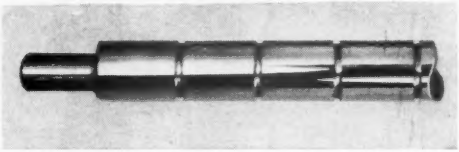
Hyprez Diamond Compounds produce the best finish on STEEL, CHROME-PLATE, TUNGSTEN-CARBIDES, BORON-CARBIDE and other surfaces, in a fraction of the usual time. They contain exclusively clean, uniform diamond cutting particles permanently suspended in a vehicle of new and original formula (patent applied for).

Hyprez Diamond Compounds are available in a wide range of grades from fastest cutting to finest polishing.

"BEAUTIFUL FINISH-FAST"

The superintendent of the polishing room of a large New England manufacturer says this of Hyprez Diamond Compound: "We had a most difficult mold to make for a transparent plastic case for a military medal. Such molds have to be perfect in finish and contour.

"We were just about stumped with the job until we found out about Hyprez Diamond Compound which did a beautiful and fast finishing job for us. We were complimented by the government inspector that our case was the most perfect job of any he had seen."



Above — Center section of Tungsten-Carbide Die. Below — Section of Tungsten-Carbide Mandrel, 10" length, o-a. Photos by courtesy of Carbide Alloys Division, Allegheny Ludlum Steel Corporation, Detroit, Michigan.

ENGIS EQUIPMENT COMPANY

431 SOUTH DEARBORN STREET • CHICAGO 5, ILLINOIS

Representatives in all Principal Manufacturing Areas

DREMEL

Improved
MOTO-TOOL

Put the "POCKET SIZE MACHINE SHOP" *to work*

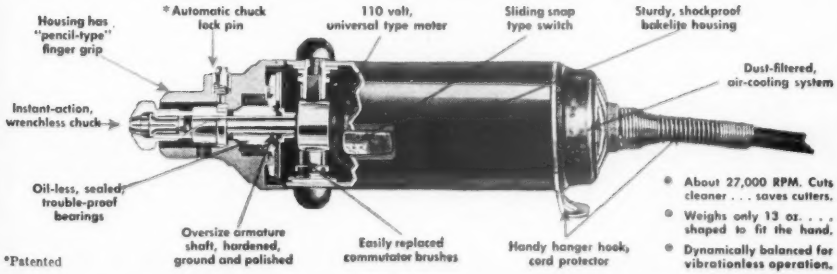
Moto-Tool Kit No. 2 Has 28 professional accessories and Model 2 Moto-Tool in wood case. $25.50. (Items purchased separately would cost about $30.00; you save $4.50)
Moto-Tool No. 2 with one emery point $15.00

Dremel's improved, "pocket size machine shop" . . . the famous Moto-Tool . . . can save you hours, by speeding up work now being done by hand. It cuts, grinds, routs, carves, engraves, cleans and polishes. Invaluable as a sharpening tool alone . . . for taps, drills, gouges, chisels, tools and cutters (without tearing down "set-ups"). Moto-Tool is a "war veteran" . . . thousands of them were used at far-flung maintenance bases by every branch of the armed forces. For years such plants as General Electric, Westinghouse, Remington Arms, Ford, Nash-Kelvinator, Consolidated Aircraft, Northrup, Douglas, etc. . . . have bought Moto-Tools for use in tool rooms and on production lines.

Moto-Tool Stand (left) made of heavy cast iron, holds Moto-Tool at any position or angle. . $4.50

Moto-Tool Shaping Table $2.50. (Shown with stand, right). Aids accuracy in routing and grinding.

LOOK FOR THESE MOTO-TOOL FEATURES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*Automatic chuck lock pin
110 volt, universal type motor
Sliding snap type switch
Sturdy, shockproof bakelite housing
Dust-filtered, air-cooling system
Instant-action, wrenchless chuck
Oil-less, sealed, trouble-proof bearings
Oversize armature shaft, hardened, ground and polished
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Handy hanger hook, cord protector

- About 27,000 RPM. Cuts cleaner . . . saves cutters.
- Weighs only 13 oz. . . . shaped to fit the hand.
- Dynamically balanced for vibrationless operation.

*Patented

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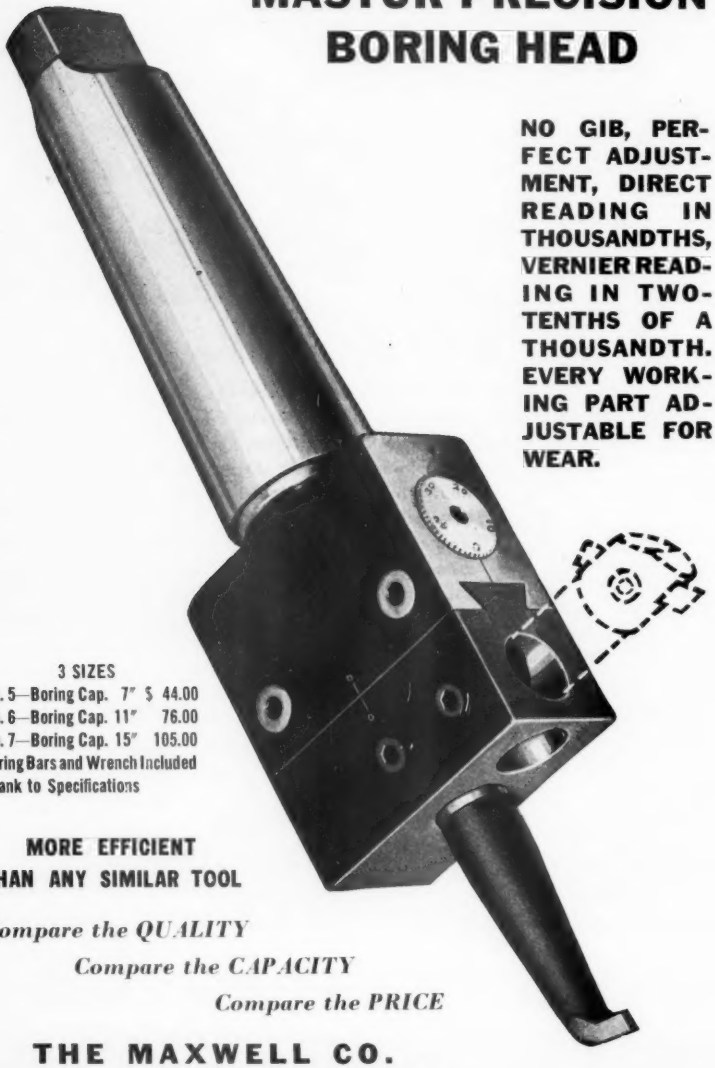
IF HE DOES NOT HANDLE MOTO-TOOL, WRITE THE FACTORY

DREMEL MFG. CO. - Dept. 527-A - RACINE, WISCONSIN

MASTUR PRECISION BORING HEAD



NO GIB, PERFECT ADJUSTMENT, DIRECT READING IN THOUSANDTHS, VERNIER READING IN TWO-TENTHS OF A THOUSANDTH. EVERY WORKING PART ADJUSTABLE FOR WEAR.

3 SIZES

No. 5—Boring Cap.	7"	$ 44.00
No. 6—Boring Cap.	11"	76.00
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Boring Bars and Wrench Included
Shank to Specifications

MORE EFFICIENT THAN ANY SIMILAR TOOL

Compare the QUALITY

Compare the CAPACITY

Compare the PRICE

THE MAXWELL CO.

225 Broadway **Bedford, Ohio**

Let's Talk it Over

Bunell is a good company with which to do business. It has the men, experience and equipment for the design and manufacture of tools, dies, jigs, special machines, gauges, fixtures.

26 years experience in design, design and build, or build from customer's prints. Factory is modern—40,000 square feet of floor space. Equipped to handle everything under one roof, from engineering to finished inspection—from drafting board to ultimate product. Units from one ounce to 20 tons—to 1/10,000 of an inch tolerance.

Equipment is complete and flexible—175 machines. 35 competent engineers. Skilled machinists. Management by practical engineers who have come up through the shop ranks—same since organization in 1920.

Additional Bunell services include an on-the-job, outside plant check-up for the analysis and review of equipment and procedures in customer's own plants to determine solution of problems. This work is on the same charge basis as work done in our plant.

[*Ask for your copies of Bunell's booklets, "The Captive Shop", "Obsolescence", "Lets Talk It Over".*]

THE

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MACHINE and TOOL COMPANY

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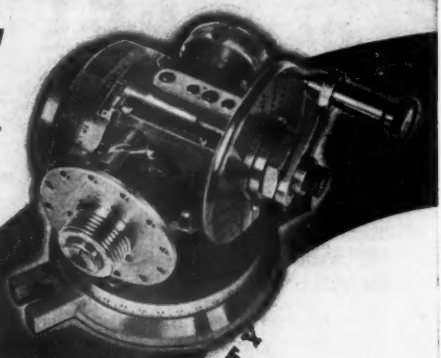
DOUBLE SWIVEL
DIVIDING HEAD

6½" SWING
(OR 11" WITH
RISER BLOCKS)

SPEED

ACCURACY

FLEXIBILITY



ELLIS DIVIDING HEAD
WITH QUICK INDEXING
ARRANGEMENT AND SWIVEL
BASE, INCLUDING DRAW-IN
COLLET ATTACHMENT.

STANDARD ELLIS DIVIDING HEAD
WITH QUICK INDEXING ARRANGE-
MENT AND TAIL STOCK.

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44 CHURCH STREET • NEW YORK 7, N. Y.

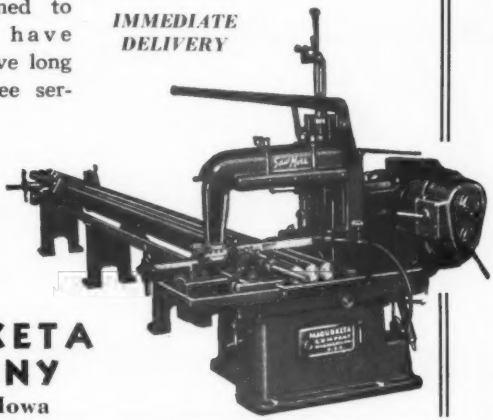
★ FAST
★ ACCURATE
★ EFFICIENT
★ PRECISION
METAL CUTTING

Choice of industry — the world over — where outstanding performance is important. Saw-more metal cutting machines bring higher production — man hour savings — and finer, more accurate work wherever they are installed.

Saw More
Metal Cutting Machines

Rugged — machined to perfection — they have what it takes to give long life and trouble-free service.

IMMEDIATE DELIVERY



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Write today for Literature, prices and detailed specifications.

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MAQUOKETA COMPANY
Maquoketa, Iowa

85% *Reduction in* GAGE COSTS

No. of Holes Gaged	Cost of Regular AGD Unplated Plug Gages	Cost of Reversible Chrome Plated Size Control Plug Gages
10,000	10 @ $10.00 Total $100.00	1 @ $15.00 Total $15.00

Figures based on 1000 holes per regular AGD unplated gage before end wore undersize. Size Control Chrome Plated Reversible Plug Ends give 10 times that service.

SAVE WITH SIZE CONTROL REVERSIBLE PLUG GAGES

Reduced plug replacement costs . . . reduced possibilities for passing sub-standard parts—you save two ways with these longer-lasting, Size Control Gages. Available in plain or plated steel or Stellite, Norbide, Kennametal, and Sapphire. Send for Catalog 47 which also describes other precision gages.

Reversible Plugs—plain or threaded they reverse quickly in pin-vise handle to give double service. Worn tips can be cut off at each end and new section exposed for six-fold service.

Entire Plug Surface Usable—straight, untapered pieces provide uniform gaging surface over entire length—finished to 1½ micro-inches or less for minimum wear.

Pin-Vise Aluminum Handle—positive locking; plugs can't slip. Easily loosened for replacing or reversing plugs—plug length adjustable for different hole depths.

2 Gages in 1—double end saves time in all gaging operations. "GO" end green finish; "NO-GO," red, for fast, easy recognition.

OTHER SIZE CONTROL CO. Extra Values!

(1) Truncated Set Plugs—give greater value.
(2) Ring Gages root relieved on major diameters permit more resets.
(3) Carbide and Chrome Gages and Measuring Wires.
(4) Master Gage Tracing Sheets—send for this unique new drafting room time saver—free!

PRECISION PLUS PRODUCTION WITH CENTERLESS LAPPING

Size Control's new Centerless Lapping Machine gives a precision finish of 2 micro inches or less to cylindrical parts. Requires no special operating skill—piece is simply placed between lapping rolls. No costly set-ups or special tools — handles diameters from .010" to 10.00" with speedy adjustment of roller spacing. Send for Catalog 47.

Phone Monroe 6710

SIZE CONTROL COMPANY

MAKERS OF PLAIN AND THREADED PLUG GAGES—GAGE SETS—DRILL SETS—
FRACTIONAL SETS—THREAD WIRES—GEAR WIRES

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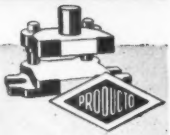
Division of
AMERICAN MACHINE & GAGE COMPANY
SIZE CONTROL CO. Precision Gages
WALSH PRESS AND DIE CO. Punch Presses
WACKER SALES DIVISION Precision Inspection Equipment

PRODUCTO HAND TAPPERS

The one machine needed in every tool, die and machine shop. Will save its cost many times over. Designed for toolroom work to close limits. Built to withstand hard shop use. Quickly adjustable to position taps at any place on table. Now made in 3 sizes... 2 bench types, capacities 1/4" and 1/2" taps; and Universal Pedestal type, capacity 1" taps. Once in your shop, you will never be without it. Write for descriptive bulletin.



THE PRODUCTO MACHINE CO.

990 Housatonic Ave., Bridgeport 1, Conn. ● Bridgeport 4-9481

PRODUCTO SERVICE IS ALWAYS AT THE PHONE ON YOUR DESK

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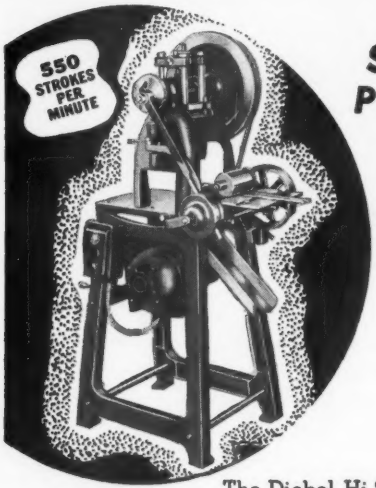
DIEBEL

Hi-Speed 550 R.P.M. AUTOMATIC PRESS



STEPS UP PRODUCTION

CUTS COSTS

on all Small Stampings

METAL
PLASTIC
FIBRE
PAPER
RUBBER
LEATHER

The Diebel Hi-Speed Punch Press requires less floor space—less power—increases production—is safer—releases heavier presses for other production.

Remember—this versatile Hi-Speed Automatic Press is adjustable up to 550 strokes per minute!

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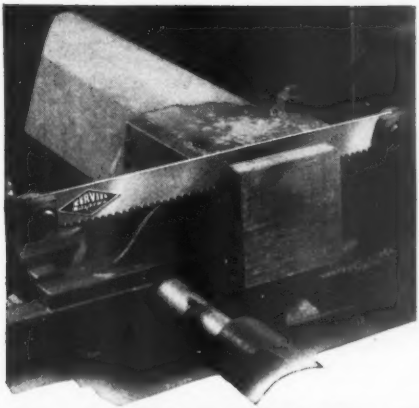


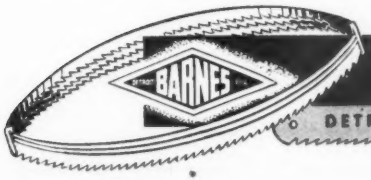
PUT THE *Right* BLADES ON YOUR POWER MACHINES

BARNES POWER HACK SAW BLADES

Choosing the *right* blade is important! Equally important is the adjustment of your power saw and the correct feed and speed for the particular sawing operation. Only then are you assured fast, dependable metal cutting, maximum cutting efficiency and economical blade life.

Make use of the handy free Barnes Hack Saw Production Calculator and Barnes factory-trained Service Engineers who can render you invaluable assistance and help you attain top sawing efficiency. Call your distributor.

There is an Industrial Supply Distributor near you carrying a complete line of Barnes hack saw blades and metal cutting band saws. He is interested in serving you—call him today!

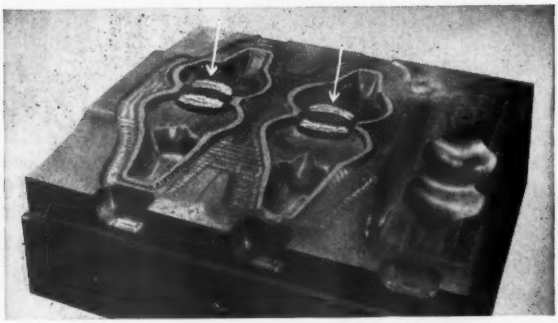


ESTABLISHED 1919

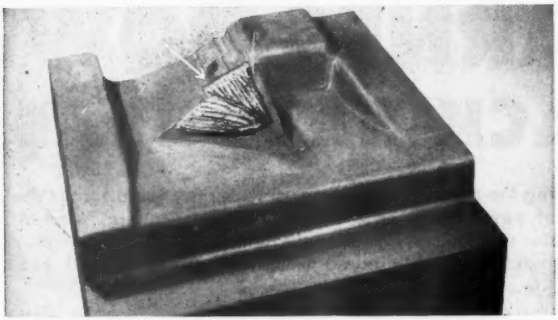
W. O. BARNES CO., INC.

DETROIT 14, MICHIGAN

Do you know that the life of your forging dies can be extended?



Typical repair to forging die with Eureka "Drawalloy" electrodes.



Plow-share forging die refaced with Eureka "Drawalloy" electrodes.

● Save tons of forging dies and untold man-hours by eliminating resinking operations! Eureka "Drawalloy" welding electrodes do the trick by *rebuilding to original dimensions* the contours of forging dies that have heat-checked or spalled!

You can efficiently rebuild defective forging dies with "Drawalloy" electrodes and *welded deposits will match the characteristics of typical forging block steel!* Welded and adjacent areas can be machined to the original dimensions of the die! Also effectively used for die repair. Send today for full descriptive literature. No obligation.

EUREKA TOOL STEEL ELECTRODES FIND THE SPOT

Welding Equipment & Supply Co.

PIONEERS IN TOOL AND DIE WELDING ELECTRODES

223 LEIB STREET • FITZROY 3715 • DETROIT 7, MICHIGAN

Save production time with a SHOPLIFTER

- **Light, Compact**
- **Easily Moved About**
- **One-Man Operated**
- **Wide Range in Application**
- **Saves Production Time**
  in handling dies and heavy fixtures; stacking barrels, boxes, etc.; loading and unloading trucks

Specifications

Type—D
Capacity—500 lbs.
Overall height—72"
Platform lift—54" above floor level, lowers to within 5" of floor
Baseframe—24" wide x 33" long
Platform—24" x 24", steel plate
Entire frame of machine of structural steel, electrically arc welded throughout
Basewheels—4" diameter, iron wheels
Crank up and down hoist unit
Two swivel casters and two stationary wheels with push bar furnished
Painted olive green finish
Weight—250 lbs. (approx.)

Heavier capacities up to 5,000 lbs. also available. Write for details.

Prompt Delivery . . . Price $157.50. Full freight allowed

Foot Operated Floor Lock—$10.00 extra

ECONOMY ENGINEERING CO., 2659 W. Van Buren St., Chicago 12, Illinois

MULTIPLE *Savings*

Here one Cincinnati Press Brake producing steel cabinets has replaced a battery of machines—changed repeated floor-to-floor handling to one simple hand-to-hand transfer. The work is merely passed from man to man along one machine to complete the series of operations.

Manning has been practically eliminated, product has been improved, investment lowered, floor space conserved.

Perhaps a similar saving might be effected in your shop. Send us your problem.

Write for Catalog B-2

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS - SHEARS - BRAKES

the A-B-C's of

SCULLY-JONES ARBORS

A bsolute Accuracy

B etter Service

C ontinual Cost Reduction

Absolute Accuracy, as well as stamina, are assured in long production runs, because of the careful heat treating and grinding of Scully-Jones Arbors, at every step from rough forgings to finished tool.

Better Service to you, because large stocks of Scully-Jones Arbors are maintained from which your requirements can be filled immediately.

Continual Cost Reduction is accomplished by Scully-Jones Individual Arbor Set-Ups.

Standard Arbors for all machines having N. M. T. B. Tapers. See Pages 112 and 114, Scully-Jones Catalog No. 500, for Style A and B Arbors. Send drawings or specifications for prompt quotations on special arbors.

Refer to the Scully-Jones Catalog showing over 500 types and sizes of cutting tools, collet chucks, boring equipment, reamers, etc.

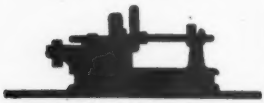
Scully-Jones AND COMPANY

2056 **1913 SOUTH ROCKWELL STREET • CHICAGO 8, U.S.A.**

SET YOUR MACHINES LEVEL WITH Empco JACKS

Saves set up and re-leveling time

Self aligning on uneven floors



Accurate two-way adjustment

Machine Tool Manufacturers strongly emphasize the need, not only to set machines level, out to KEEP 'EM THAT WAY. Periodic re-leveling is essential for accurate work tolerances. How often, depends on the type of foundation. No method of machine setting is stable enough to maintain the accuracy of initial leveling. It is important to check after first month of operation, then check periodically and re-level whenever necessary.

When a machine is set on EMPCO JACKS the whole operation is the work of only a moment: Simply apply a wrench to the "hex" screw head, turn right to lift or left to lower until your level indicator reads "zero".

Write for descriptive folder. Prompt delivery.

SIZES AVAILABLE
No. 1...2 " normal height
No. 2...2⅜" normal height
No. 3...3¾" normal height

EMPCO

THE ENTERPRISE MACHINE PARTS CORPORATION
2735 JEROME AVE. DETROIT 12, MICH.

How many of these parts have YOU replaced?

• If you're using a Monarch Turning Machine the answer is easy—with rare exceptions it's "*None*".

Every dark area in this phantom view indicates a hardened bearing surface or a part made of hardened alloy steel. Induction-hardened lead screws—flame-hardened ways—these are two typical examples of how Monarch design gives you *peak production at a profit*—and dependable long life at sustained accuracy.

When you want the ultimate in performance, Monarch Turning Machines—*with hardened structure*—will give you the most for your money *at any price.* May we furnish more details?

ACCURACY · ECONOMY · LONG LIFE
Monarch
TURNING MACHINES

THE MONARCH MACHINE TOOL COMPANY · SIDNEY · OHIO

Designed for SHOCK PROOF ROTARY POWER

● The "Floating Drive" in these unique motors *eliminates* shock troubles! The punishment and abuse of constant starting, stopping, braking, acceleration and reversal can't damage it! There are no mechanical linkages of any kind between the driving and driven elements—yet the driving element is in *constant pressure* contact with the driven element at all times!

A speed-control valve assembly can be added to permit presetting of the motors at any rpm within their capacity, and gear heads are available in a variety of gear ratios. For efficiency on rapid-traverse needs, a plunger device on the speed-control valve permits instant acceleration from any preset speed to full speed. Motors resume preset speeds instantly upon release of the plunger.

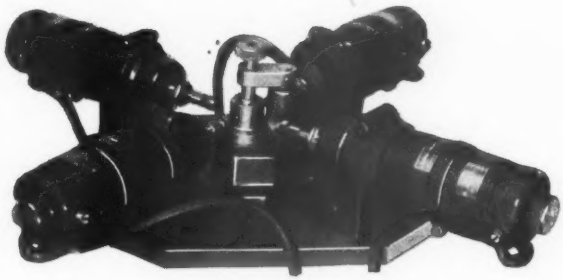
These motors have no "dead-center" positions—they start instantly when pressure is applied. They are also fully self-lubricating, with or without the gear-head and speed-control assemblies. Available in 3 and 5 hp sizes, with gear heads in 3:1, 1:3, 1.5:1 and 1:1.5 ratios. Write for details.

DENISON Hydroilic

FLUID MOTORS

DENISON EQUIPMENT for APPLIED Hydroilics

The DENISON Engineering Co., 1197 Dublin Rd., Columbus 16, Ohio



A Simple Set-up for Multiple Drilling

With the set-up illustrated, 4 holes can be drilled at once with Govro-Nelson Self-Contained Automatic Drilling Units. The number of holes drilled simultaneously can, of course, be increased or diminished, according to the requirements of any particular drilling job. Likewise, the location of the holes can be changed by re-locating the Units, making the set-up adaptable to different production runs.

Here's a drilling method that may well prove to be the answer to your problem of reducing production costs. It is being adopted so widely that our list of users reads like a directory of America's production industries.

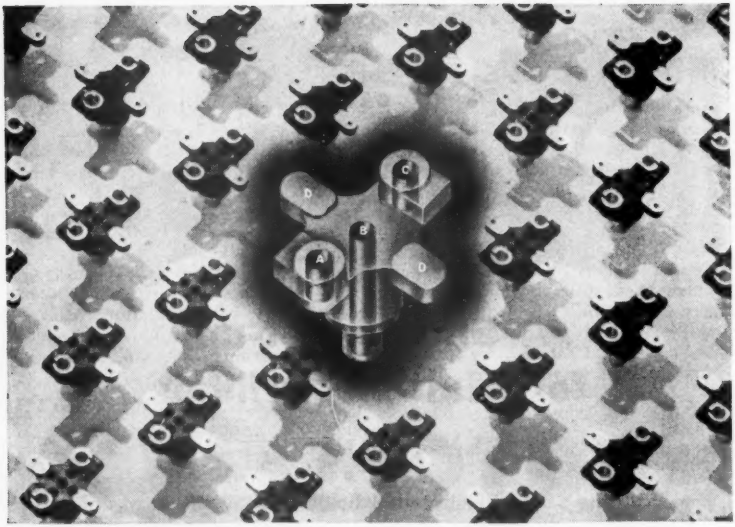
Send for literature giving list of prominent users, together with typical applications covering a variety of drilling jobs.

WRITE FOR *Literature*

GOVRO-NELSON CO.

1933 Antoinette
Detroit 8, Mich.

Automatic **DRILLING UNIT**



How to use the *Moore Jig Borer* as a Production Machine

Three holes located and sized, two pads milled—in a single set-up; 5,000 parts—6 minutes each.

Are you limiting the capacity of your jig borer to toolroom work? You needn't...if it's a Moore Jig Borer.

For this versatile machine often outperforms production machines. Here's proof: Holes A, B and C were located to .0005", sized to +.0005",—.0000" and parallel to .001" checked on plugs 1" long, two pads D milled to ±.001"... in one set-up.

A drill jig couldn't handle such tolerances; reamers and bushings would wear. Besides, aluminum is not free-machining.

The only answer was single-point boring. After the holes were roughed out with a jig costing $75, the Moore Jig Borer machined them to exact location and size, and milled two pads. The entire operation required only six minutes each.

Such speed and accuracy are the result of the Moore Jig Borer's sensitive spindle which provides speeds to 2,600 RPM, and quick-setting lead screws. The latter, ground to an accuracy of .0002" in 16", enables you to spot, drill, bore and ream holes in one set-up, with minimum tool changes.

Remember this versatility when you specify your next jig borer. Meanwhile, write for illustrated literature.

MOORE SPECIAL TOOL CO., INC.
728 UNION AVENUE, BRIDGEPORT 7, CONN.

MOORE JIG BORER

MOORE TOOLS

SPOTS, DRILLS, BORES, REAMS...WITH MINIMUM TOOL CHANGES

GAGE BLOCK INSPECTION SERVICE

$15.00

84 BLOCK SET

(Other sets proportionately low)

DON'T LET DOUBT CAUSE CONTROVERSY
. . . IT COSTS SO LITTLE TO BE SURE!

Webber opens its inspection facilities to all users of gage blocks regardless of make. The wear inflicted through daily use over a period of months is sufficiently great to warrant careful examination at periodic intervals. The absence of this precaution can cause controversy and production difficulties. Avoid trouble, send those gage blocks to Webber, now.

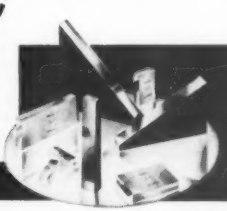
YOUR CERTIFICATE OF ACCURACY

1. *We will return the gage blocks with a Certificate of Inspection showing present size in comparison with master blocks CERTIFIED by the U. S. Bureau of Standards.*
2. *Removal of burrs and nicks which impair accuracy.*
3. *Identification of those blocks beyond repair—along with a recommendation for replacement.*

Webber Gage Co. • 12903 Triskett Rd. • Cleveland 11, Ohio

WEBBER MAKES PRECISION GAGE BLOCKS EXCLUSIVELY

- ★ Gage Block Sets in Steps of .00005"
- ★ Individual Special Size Blocks.
- ★ Heavy Duty Gage Blocks.
- ★ Angle Gage Blocks in Steps of one second.
- ★ Carblox (Carbide) Wear Gages.



Webber PRECISION GAGE BLOCKS

With Two DI-ACRO BENDERS

A difficult production problem of forming two bends in a long length of tubing was solved by "teaming up" two DI-ACRO Benders as illustrated. This dual-forming arrangement saved installation of special machinery. Two accurately formed bends are obtained in one operation—without distortion of the tube and at a cost competitive to power operated equipment. More than 300 pieces are completed per hour—600 individual bends.

"DIE-LESS DUPLICATING" Often Does it Quicker WITHOUT DIES

This is but one example of how DI-ACRO precision machines —Benders, Brakes and Shears—can accurately and economically duplicate a great variety of parts, pieces and shapes, without die expense. Write for catalog—"DIE-LESS DUPLICATING".

◀DI-ACRO is pronounced "DIE-ACK-RO".

DI-ACRO PRECISION MACHINES DIE-LESS DUPLICATING

O'NEIL-IRWIN MFG. CO.

315 EIGHTH AVENUE • LAKE CITY, MINNESOTA

Continental

COUNTERBORE SETS

A Size For Every Purpose

CONTINENTAL Interchangeable Counterbores are now available in a choice of three sets, each providing a wide variety of useful, dependable tools. In complete yet compact form, you will find a selection designed to fill the needs of the large or small toolroom. Set No. 1 (illustrated), for the small shop, includes cutters up to 1 1/16" diameter, with two holders. Whichever set you choose, you will get fine, precision-made cutting tools.

THE indestructible drive and rigid, yet simple, construction of the Continental Interchangeable Counterbore assure long dependable service.

CONTINENTAL TOOL WORKS

Division of Ex-Cell-O Corporation

DETROIT 6, MICHIGAN

CTW

Continental

CUTTING TOOLS

- Boring Bars and Tools
- Broaches
  Broach Pullers
  Broaching Fixtures
- Core Drills
- Counterbores and Countersinks
- CTW Drive Holders
- Counterbores (Tool Room Sets)
- Counterbore Pilots
- Inserted Blade Cutters
- Carbide Tipped Cutters
- Form Relieved Cutters
- Milling Cutters
- Thread Milling Cutters
- End Mills
- Side Mills
- High Speed Steel Reamers
- Carbide Tipped Reamers
- Shell Reamers
- Inverted Spotfacers
- High Speed Steel Tool Bits
- Carbide Tipped Tool Bits
- Circular Form Tools
- Cut-off Tools
- Flat Form Tools
- Dovetail Form Tools

46-44

REPUTATION . . .

IS QUALITY THROUGH THE YEARS

Quality is value insurance to the purchaser. Thus, reputation for quality is the sum total of countless thousands of full-value products and services, delivered uninterruptedly over a long period of years.

But to Behr-Manning, *lasting* reputation is more than time's stamp of approval for past performances. The needs of the future for progressively improved quality are to us a twofold challenge—a challenge in research and a challenge in methods engineering.

The first challenge is a stimulus to build ever better coated abrasives, which in turn will produce more units and finer finishes, faster, and at lower cost. The second is a crusade to bring to Industry's cost-stricken production lines the relief of lower-cost abrasive methods.

Dedicated to the accomplishment of these objectives, we enter our fourth quarter-century of quality and service to Industry.

BEHR-MANNING · TROY, N. Y.
(DIVISION OF NORTON COMPANY)

Grinding department of Tools & Gages, Incorporated. See detailed list of equipment below.

tired of the Old Grind?

We'll take it over. Grinding is our business. We have the equipment (see list at right) and the skilled manpower for *any* kind of grinding . . .

From the simplest surface grinding to the most intricate form grinding . . . from relatively easy tolerances to tenths or less, if necessary . . . from one piece to large quantities . . . at lowest prices possible for the accuracy you require.

Send us your prints for firm quotations and dependable delivery commitments to any point in the United States.

GRINDING DEPARTMENT EQUIPMENT

12—Surface Grinders
1—No. 11 Blanchard Grinder
1—No. 22 Heald Rotary Grinder
4—Internal Grinders
4—External Grinders
3—36"J & L Optical Comparators
2—Toolmakers Microscopes
42—Sets of Gage Blocks (81 blocks per set) providing one set for each Grinder Hand and Gagemaker

Remainder of our shop is equally well equipped and provides facilities for supplying all of your requirements on tools, gages, special machines or precision components.

BUILDERS OF PRECISION TOOLS GAGES • • JIGS • • FIXTURES

TOOLS *and* GAGES

INCORPORATED

3112 EAST 63rd STREET • CLEVELAND 4, OHIO

MICHIGAN 7230

MO-MAX IS TOUGH AND HARD

IT IS DIFFICULT to exaggerate the value of the ideal combination of **toughness and hardness** found only in MO-MAX. No other high speed steel surpasses MO-MAX in these important qualities. For 13 years MO-MAX has demonstrated its outstanding superiority and economy in every kind of cutting tool.

Check the other "plus" features which MO-MAX alone possesses. Order by brand name from one of the mills listed at the left.

Buyer's Guide to Brands of MO-MAX

"LMW"..... Allegheny Ludlum Steel Corp.
"MOHICAN"..... Atlas Steels Limited
"BETHLEHEM HM"... Bethlehem Steel Co.
"MO-CUT"..... Braeburn Alloy Steel Corp.
"STAR MAX"..... Carpenter Steel Company
"MOLITE M-1"... Columbia Tool Steel Co.
"REX T-MO" Crucible Steel Co. of America
"DI-MOL"..... Henry Disston & Sons, Inc.
"HI-MO"..... Firth-Sterling Steel Company
"REX T-MO"..... Halcomb Steel Company
"MOGUL"..... Jessop Steel Company
"TATMO"..... Latrobe Electric Steel Co.
"MIDMAX"..... The Midvale Co.
..... St. Lawrence Alloys, Inc.
"S. T. M."..... Simonds Saw & Steel Co.
"MO-TUNG"..... Universal-Cyclops Steel Corporation
"8-N-2"..... Vanadium-Alloys Steel Co.
"VUL-MO"..... Vulcan Crucible Steel Co.

ONLY MO-MAX GIVES YOU *all* THESE ADVANTAGES

1. MO-MAX has superior cutting qualities. It is a happy combination of great toughness with high hardness.
2. The machinability of MO-MAX is unexcelled, particularly in grinding.
3. MO-MAX is economical. Its specific gravity is about 8% less than that of 18% tungsten steel. Thus for the same weight of high speed steel, 13 bars of MO-MAX are obtained as compared with 12 similar bars of an 18% tungsten steel.
4. In addition to the standard general-purpose composition of MO-MAX high speed steel, several special types have been developed for particular purposes. There are four with a high cobalt content, one high in vanadium and two that are especially suitable for hot die work.
5. MO-MAX was the first of the modern molybdenum high speed steels. For 13 years MO-MAX has demonstrated its superiority in cutting tools.

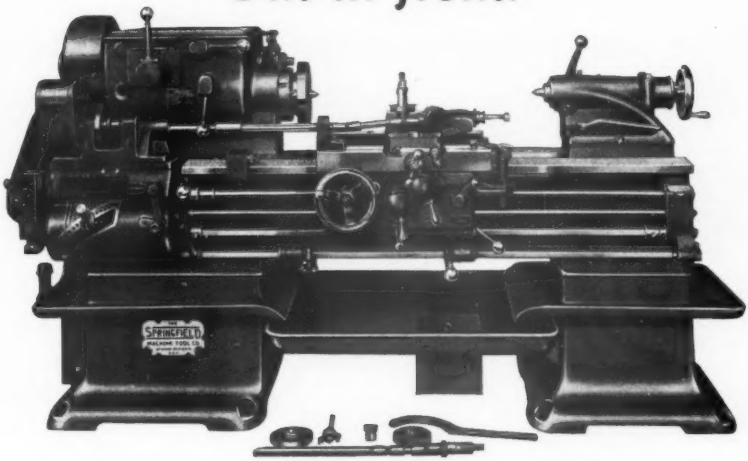
★ ★ ★

Send for your copy of the MO-MAX Handbook, sixth edition. Get the full story about this remarkable steel, including easy-to-follow instructions on heat treating.

THE CLEVELAND TWIST DRILL COMPANY • 1260 East 49th Street • Cleveland 14, Ohio

SPRINGFIELD PRECISION LATHE

Out in front!



SEND TODAY FOR BULLETIN No. 163

Tells the why and how of Springfield's accurate production.

● Headstock . . . twelve speeds . . . only half of the easy-shifting spur gears mesh at one time.

Motors . . . V-Belt or silent chain drive.
Bed . . . permanently true—made of high test alloy to resist warp or marring under severe service.

Apron . . . extra heavy—operates on Ball and Bronze bearings throughout.
Taper attachment . . . hair-trigger adjustment.

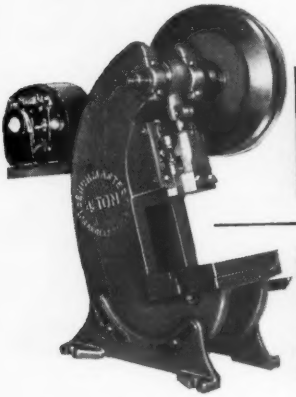
Compound rest . . . sturdy, firm.
Tailstock . . . all bearings and bed ways oiled from one well.

From headstock to tailstock—the SPRINGFIELD Lathe is *out in front!*

THE SPRINGFIELD MACHINE TOOL CO.
SPRINGFIELD • OHIO, U. S. A.

Benchmaster's* Improved Model

4-TON CAPACITY BENCH PUNCH PRESS



* World's largest manufacturer of small presses.

Small in Size

MIGHTY in Performance

FOR STAMPING, MARKING, PUNCHING, RIVETING, FORMING AND OTHER HIGH-SPEED OPERATIONS

Light, compact and powerful, the improved, postwar Benchmaster 4-Ton Capacity Punch Press offers performance formerly found only in far larger models. Its unusual and exclusive features include a cradle base that allows the press to be inclined, a precision-ground shaft keyed by a press fit to a large eccentric to provide shock-absorbing bearing surface, bronze bushings at all wear points, a single trip action that may be made to repeat rapidly by removing a screw located in the collar, automatic knockout, an open back so that work may also be inserted from the front, a new-type floating motor mount which maintains proper tension of the V-belt, standardization of parts for quick, easy interchangeability and many other typical Benchmaster improvements.

For full information about this new Benchmaster Punch Press and other quality Benchmaster machine tools, write to Dept. **TDJ-1.**

SPECIFICATIONS:

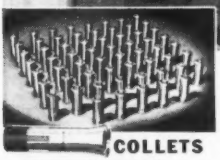
Weight, 215 lbs.
Height, 27"
Die space, 5¾"
Center of bolster plate to frame, 3⅜"
Bolster plate, 6" x 8" x 1" with 2" hole in center
285 strokes per minute with 1725 R.P.M. electric motor
1" stroke standard
Other strokes up to 2" special

benchmaster MANUFACTURING COMPANY
2952 WEST PICO BOULEVARD
LOS ANGELES 6, CALIFORNIA

benchmaster tools

TO INSURE ACCURACY, USE—

SOUTH BEND *Precision* LATHES



COLLETS

Equip Your Lathes with Complete Sets

A complete set of collets is especially helpful for toolroom and maintenance work. Often the time saved in getting out a single rush job without having to wait for a specially ordered collet will more than compensate for the cost of a full set of collets. South Bend Collets are made in four types, and are available in either steel or brass. Each collet is carefully inspected and tested before it is packed for shipment.

South Bend Lathes help to increase plant efficiency and profits by raising precision standards both in the toolroom and in the production shop.

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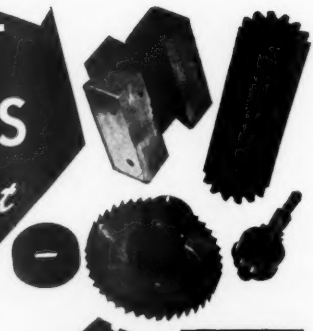

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- One model, 2 sizes, to heat to 1850° F.
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- Uniform temperatures assure results.

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- Made of extra tough, heat treated alloy steel; unconditionally guaranteed not to bend or give way
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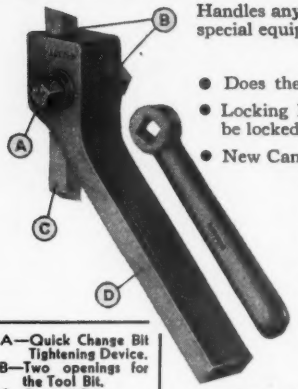

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2	7/16 x 3½	⅝ x 1⅜ x 7

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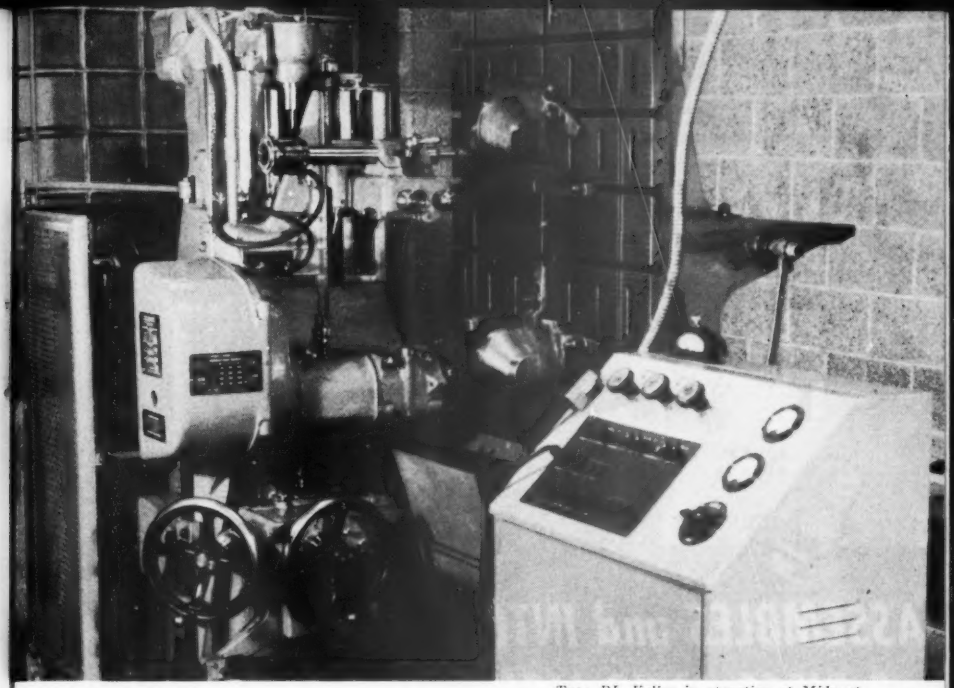

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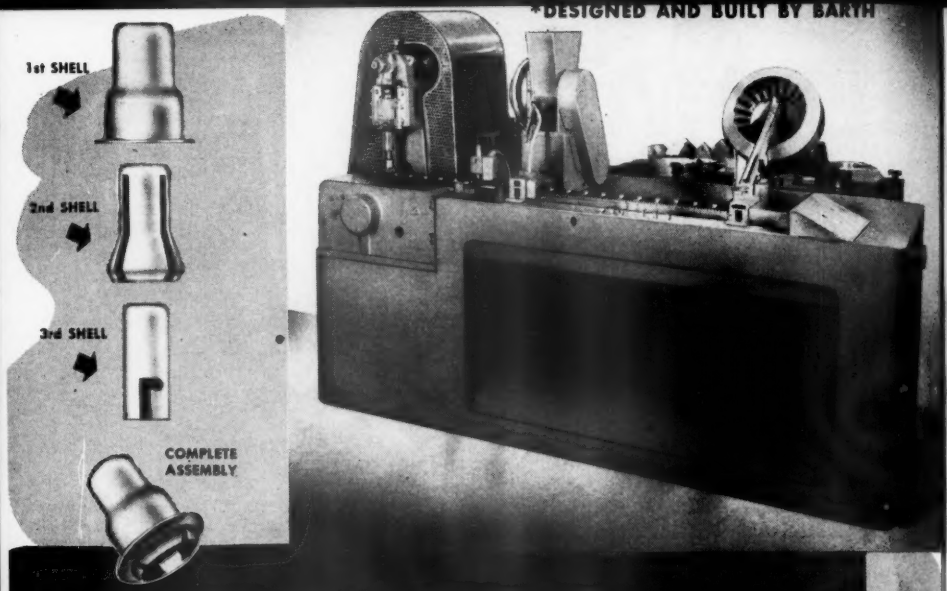

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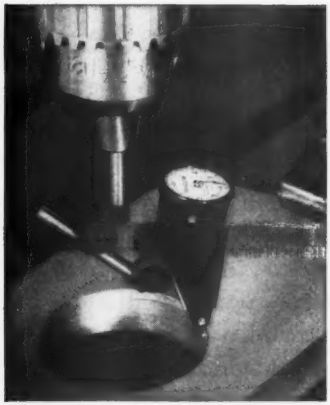

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toolmaking do's and don'ts

Any accounting of present attainments in American mass production is a history of, and tribute to, those men whose know-how and ingenuity have resulted in the tooling that has made our mass production possible.

These men have learned by doing; by designing and building the tools that cut and form metals into the product designer's blueprinted components and end products.

No two jobs are alike; their variety and complexity ranging from compound, multi-stage, press tooling, through precision jigs and fixtures that reduce production variables to fractions of thousandths, to tooling sequences for multiple spindle and chucking operations that reduce to seconds the making of vari-contoured workpieces that formerly took minutes.

Consequently the production tooling designer and builder acquires a far more intimate understanding of the behavior (and misbehavior) and practical working characteristics of metals than can be had by any other means. His skill has been acquired the hard way; the higher the skill, the harder the way.

There are no shortcuts to attaining his skills, but there are many practical points pertaining to tool design and performance that he can pass on to the product designer that would be of mutual benefit, to the end that the manufacturer of tooling would have fewer impossible jobs to battle, and the product designer would be credited with lower tooling charges against his work.

TOOL & DIE JOURNAL, with a readership representative of the highest skills and most extensive know-how in tooling manufacture, has been compiling and readying for 1947 publication a great variety of this pertinent and helpful data. An intensive and comprehensive querying of many authorities is bringing forth suggestions and aids to product designers on the practicalities of product design in relation to tool design.

It is our intent that this encyclopedic collection of know-how-proved, tooling do's and don'ts, i.e., pierced hole sizes as related to stock thickness, optimum hole spacing, practical limitations to bend-radii in relation to stock characteristics and tool life, practical ranges in screw-machine workpiece multi-diameters in terms of sfm, cutting tooth design and feeds as affecting surface finish, to mention the more obvious, shall serve to increase the product designer's appreciation of the tool designer's problems and to effect economies by minimizing design and engineering changes.

Admittedly, much of this information is available, but only from widely scattered sources, and has to be dug out the hard way. The job of collecting, compiling, interpreting and classifying is shaping up as a perpetual one, to be subject to periodic revision in its published form as new ideas are submitted and collected.

With this disclosure and explanation we invite comments from our readers as to what their experience dictates should also be included, i.e., what could you suggest to product designers that would make your job easier, that would improve tool performance and increase tool life, and that would contribute to the end result of better products through better tooling? With your help this can become an engineering tool of still greater value.

E. Willard Pennington

editor

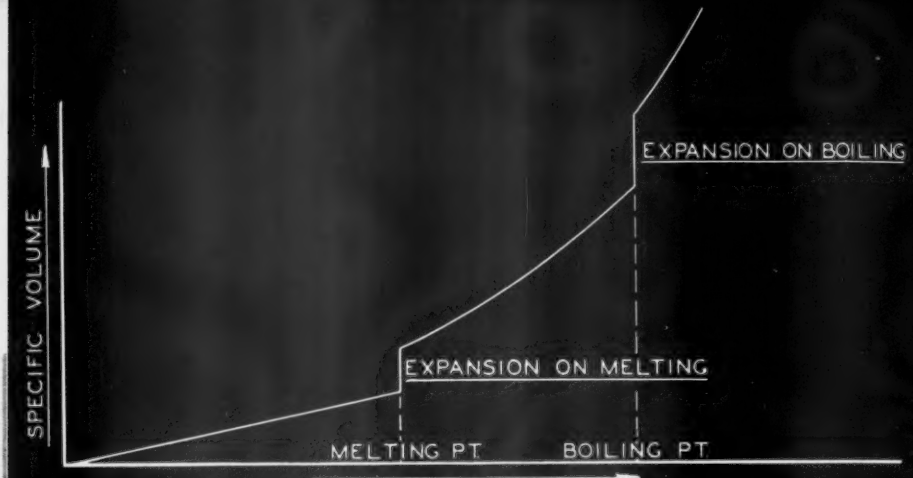


FIGURE N° 1

EFFECT OF TEMPERATURE UPON SPECIFIC VOLUME OF MOST METALS AND ALLOYS.

Shrinkage Allowance In Die Casting Die Design

In constructing a die casting die, a die maker must make allowance for shrinkage in a manner similar to that employed by a foundry pattern maker in order that the die will produce castings within the tolerances called for by the product specifications.

by R. L. Wilcox
Metallurgical Engineer
Factory Manager
Gerity-Michigan Die Casting Co.
Die Casting Division
Detroit, Michigan

Die casting die makers have found that published solidification shrinkage data for die casting alloys will apply in normal foundry work but are usually excessive for die casting work. Furthermore, a solidification shrinkage allowance calculated from published physical constants will also prove greater than that found applicable from practical experience.

The reason for this variance is that there are many factors influencing the shrinkage or change in specific volume of an alloy during a die casting cycle, and an examination of these will be helpful in better understanding this problem.

Specific Volume Changes

Most physical properties of metals and

their alloys are affected by changes in temperature, and the manner in which the specific volume or volume of a unit weight of most metals and alloys is affected by temperature can be illustrated graphically as shown in Figure 1. The slopes of the lines indicate the coefficients of expansion at each temperature and their departure from linearity indicates the temperature coefficient of expansion.

It will be seen from Figure 1 that changes in specific volume will take place with temperature changes in the solid, liquid and vapor phases of a metal or alloy. However, since in normal casting work, alloys are never intentionally heated beyond the liquid or molten state, only those specific volume changes taking place in the liquid, solid, and during the change from the liquid to the solid states will be discussed further. Also for the sake of brevity this discussion will be confined to the present day commercial zinc base alloys since in most instances similar conditions would apply for other die casting alloys.

Effect of Rate of Cooling

When a given volume of zinc alloy in the liquid state at a given temperature is gravity poured or cast into a mold or die maintained at a temperature considerably below the freezing point of the alloy, heat will be absorbed by both the mold material and the surrounding atmosphere so that the mass of metal will begin to cool at a definite rate. During this cooling process, the specific volume of the molten or liquid alloy decreases at a fairly uniform rate until the freezing point of the alloy is reached at which time there is a further sharp reduction in specific volume resulting from the change from the liquid to the solid state. As cooling progresses the solid alloy continues to shrink but at a more uniform rate until the mass of solid alloy has reached normal or room temperature.

However, because the cooling rate in normal gravity casting work out of necessity is fairly rapid and non-uniform, specific volume change or shrinkage in turn is not uniformly distributed thus resulting in the formation of pipes or shrinkage cavities. The final casting will, therefore, have non-uniform dimensions. Other factors such as methods of pouring, mold material, mold coatings, etc., affect the distribution or nature of this shrinkage but will not be discussed here. The effect of the rate of cooling upon the final casting or ingot form can be illustrated as shown in Figure 2.

Because extremely slow and uniform cooling rates are not practical in normal sand or permanent mold casting work, methods or means are devised such as the use of chills, risers, hot-tops, etc., on molds to compensate for, and more uniformly distribute, shrinkage.

Liquid-Solid Transformation

In die casting, where the liquid metal is injected or "shot" into a steel die or mold under pressures usually exceeding 1,000 pounds per square inch, the volume of the die cavity is fixed since the die is held together under pressure. Because of these conditions, the shrinkage that takes place in an alloy in cooling from the liquid to the solid state is compensated for to a large degree by continually forcing more liquid alloy into the die, keeping the die cavity completely filled as the resultant casting chills to the solid state.

For all practical purposes, therefore, the shrinkage taking place in zinc base alloys in cooling through the liquid-solid transformation can usually be disre-

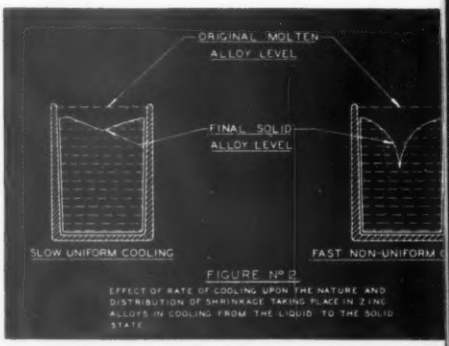
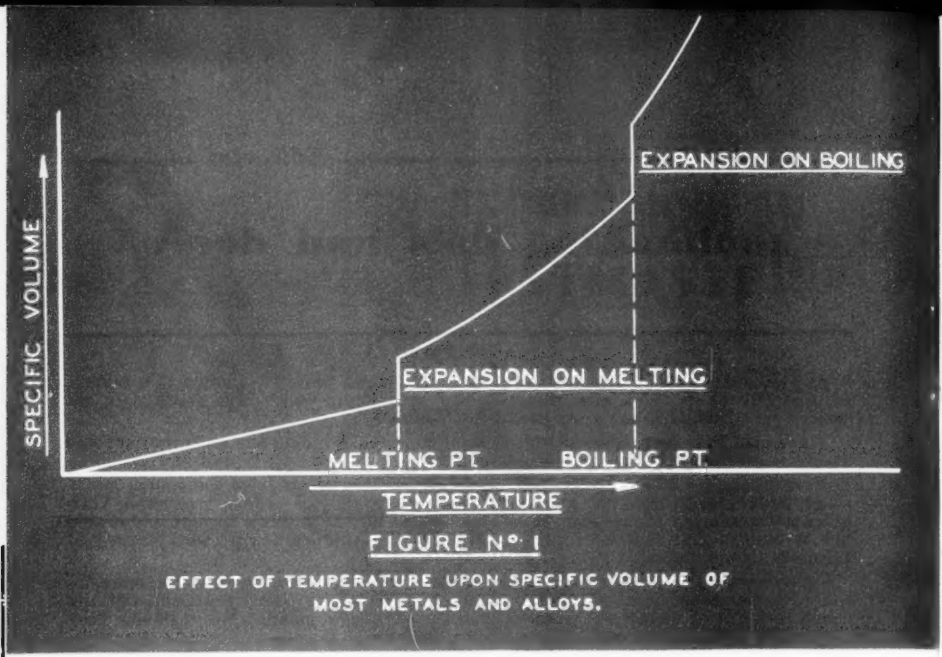


FIGURE Nº 2

EFFECT OF RATE OF COOLING UPON THE NATURE AND DISTRIBUTION OF SHRINKAGE TAKING PLACE IN ZINC ALLOYS IN COOLING FROM THE LIQUID TO THE SOLID STATE

FIGURE Nº 3



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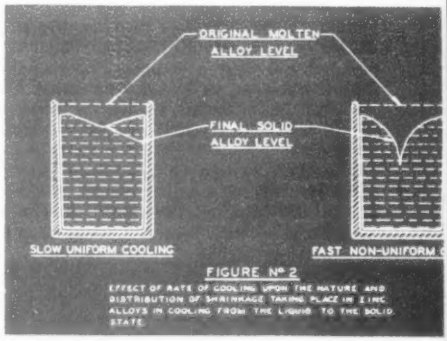

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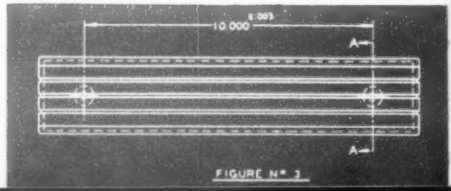


FIGURE Nº 3

garded in die casting die design work.

Volume Changes in the Solid Phase

The shrinkage or volume change that must be considered, however, is the shrinkage that will take place in the alloy casting while cooling from the temperature at which it solidifies in the die cavity to room or normal temperature.

To apply this information in the designing of die casting dies where allowance must be made for alloy shrinkage, we will take a specific example of a relatively simple ASTM No. 23 zinc alloy casting of the size and shape illustrated in Figure 3 where the critical dimension is the 10-inch length which must be held to 10.000″ ± .003 in. Furthermore, we will assume that this casting will be produced under the following temperature conditions: Metal 775° F, Die 390° F.

For theoretical purposes, we will assume that the casting illustrated in Figure 3 is formed or solidifies in the die at a temperature corresponding to the 717° F freezing point of the alloy. Therefore, the casting should shrink in cooling from 717° F down to room or normal temperature at the rate of about 0.000015″ per inch per degree F, according to published data. This works out to a total shrinkage of .000015 in. x 10 in. x (717° — 70°), or about .097″ measured over the critical 10-inch length.

However, the die cavity as machined in an SAE 6135 steel die at room temperature (70°) will also expand when heated to the proposed die temperature of 390° F at the rate of about 0.0000067″ per inch per degree F, according to published data, or a total *expansion* of .0000067 in. x 10 in. x (390° — 70°) or about .021″ over the critical 10-inch length.

Therefore, with a calculated die cavity expansion of .021″ and a casting shrinkage of .097″ the net shrinkage allowance necessary on the 10-inch critical length of the die cavity would be .097″ minus .021″ or .076″. Consequently in machining the die cavity in steel at room temperature, the critical 10-inch dimension should be machined to 10.076″ ± .001″ for these reasons alone.

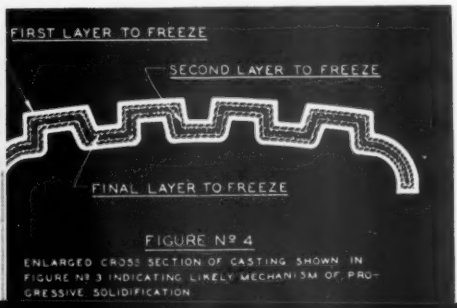


FIGURE Nº 4

ENLARGED CROSS SECTION OF CASTING SHOWN IN FIGURE Nº 3 INDICATING LIKELY MECHANISM OF PROGRESSIVE SOLIDIFICATION

Practical Versus Theoretical Shrinkage Allowance

In commercial practice, however, most die casters and die casting die makers report that in die design work they normally make a shrinkage allowance of only .005″ to .006″ per inch for zinc base die casting alloys. It will be noted that this "practical" shrinkage allowance for zinc alloys is somewhat less than the above "calculated" allowance of .076″ for a 10″ cavity or .0076″ per inch.

Influence of Metal and Die Temperature

The temperature at which a casting will be formed in a die cavity will be dependent primarily upon both the initial die temperature and the temperature of the alloy being injected or cast into the die; the temperature differential between the two governing the rate of chill or cooling. The nature of the die surface (degree of polish, presence of die coating or lubricant, etc.) and magnitude of pressure on the alloy being shot into the die also affect rate of chill but are secondary factors and will not be discussed.

To better understand the variables involved in determining the temperature (really average temperature) at which a casting is formed in a die, let us visualize what takes place when molten alloy is shot into a die cavity of the size and shape to produce the casting illustrated in Figure 3. The first volume of alloy entering the die chills and solidifies to form a skin or outer layer which approximates the shape of the casting. Cooling progresses, therefore, from the outer skin or surface to the center until the entire casting is solid. One might visualize this cooling as taking place in steps or layers as illustrated in Figure 4.

With such progressively inward cooling or solidification, the outer skin or chill surface is considerably below the freezing point of the alloy (717° F for zinc alloy ASTM No. 23) by the time the center or final portion reaches the freezing point. The thinner the cross section,

the more likely the average temperature at which the casting is formed in the die will approach the freezing point and vice versa. Since, in commercial practice, it is virtually impossible to actually determine this average temperature (which we know must be below the freezing point of the alloy) the use of a temperature differential between the freezing point of an alloy and room temperature in calculating shrinkage will, therefore, result in a greater shrinkage than will actually take place. This partially explains why practical shrinkage allowances in die casting design work are usually less than calculated.

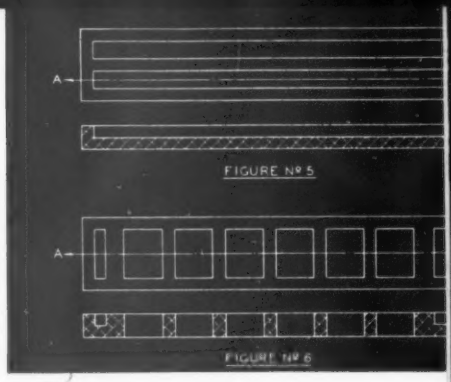
Influence of Casting Shape or Contour

Another major factor tending to reduce the shrinkage allowance factor from the calculated value for a given set of conditions is the shape of the casting or its ability to shrink freely in the die.

For example, a casting of the shape or contour shown in Figure 5 will be more likely to shrink an amount approaching the theoretical value than the casting shown in Figure 6 which is prevented from shrinking freely because of the restricting cores that produce the slots or windows and decorative lines.

As will be appreciated, very few commercial die castings are of such a shape or contour that permits unrestricted shrinkage in the die. Furthermore, the manner in which a die is gated, i.e., type and placement of gate opening, gate runner, and overflow wells, also affects the ability of a casting to shrink in a die. Therefore, in some instances with extremely complicated castings and special gating even the practical shrinkage allowance factor of .005" to .006" per inch will prove excessive.

Unfortunately, because of the many factors influencing shrinkage of a given casting produced in a die under a given set of conditions, no formula can be developed to fit all cases and individual conditions must be considered in each specific case. This is particularly true since even with good control during the die casting cycle, metal and die temperatures will vary somewhat due to periodic metal additions to the machine and to manual control of water lines cooling the die. The practical solution in most cases is to consider the longest "free shrinkage" section of such a complicated casting and estimate total likely shrinkage with this limitation in mind.



Phase Adjustment Shrinkage

In addition to the shrinkage or change in specific volume that occurs in most alloys while cooling from casting temperature to room or normal temperature, many alloys undergo further slight changes in physical dimensions as the result of phase adjustments taking place with time in the solid *after* casting.

This is particularly true of present day commercial zinc base alloy die castings which undergo a phase adjustment or shrinkage* of about 0.0007" per inch which is usually complete after about five weeks of aging at normal room temperature.

This shrinkage, while very small and usually of no consequence in ordinary die casting die design work, can be of importance on very long castings, e.g., thirty to seventy inches or longer, incorporating bosses or lugs that must fit into some fixed dimension within certain tolerances during subsequent assembly.

Therefore, when designing dies for long zinc base alloy die castings, consideration should be given to the possible need for increasing normal die shrinkage allowance to compensate for the phase adjustment shrinkage that takes place in the solid after casting.

This would apply particularly to the casting illustrated in Figure 3 where the

(CONTINUED ON PAGE 98F)

*M. L. Fuller and R. L. Wilcox: Trans. A.I.M.E. (1936), Vol. 122, pp. 231-243.

garded in die casting die design work.

Volume Changes in the Solid Phase

The shrinkage or volume change that must be considered, however, is the shrinkage that will take place in the alloy casting while cooling from the temperature at which it solidifies in the die cavity to room or normal temperature.

To apply this information in the designing of die casting dies where allowance must be made for alloy shrinkage, we will take a specific example of a relatively simple ASTM No. 23 zinc alloy casting of the size and shape illustrated in Figure 3 where the critical dimension is the 10-inch length which must be held to 10.000" ± .003 in. Furthermore, we will assume that this casting will be produced under the following temperature conditions: Metal 775° F, Die 390° F.

For theoretical purposes, we will assume that the casting illustrated in Figure 3 is formed or solidifies in the die at a temperature corresponding to the 717° F freezing point of the alloy. Therefore, the casting should shrink in cooling from 717° F down to room or normal temperature at the rate of about 0.0000015" per inch per degree F, according to published data. This works out to a total shrinkage of .000015 in. x 10 in. x (717° — 70°), or about .097" measured over the critical 10-inch length.

However, the die cavity as machined in an SAE 6135 steel die at room temperature (70°) will also expand when heated to the proposed die temperature of 390° F at the rate of about 0.0000067" per inch per degree F, according to published data, or a total *expansion* of .0000067 in. x 10 in. x (390° — 70°) or about .021" over the critical 10-inch length.

Therefore, with a calculated die cavity expansion of .021" and a casting shrinkage of .097" the net shrinkage allowance necessary on the 10-inch critical length of the die cavity would be .097" minus .021" or .076". Consequently in machining the die cavity in steel at room temperature, the critical 10-inch dimension should be machined to 10.076" ± .001" for these reasons alone.

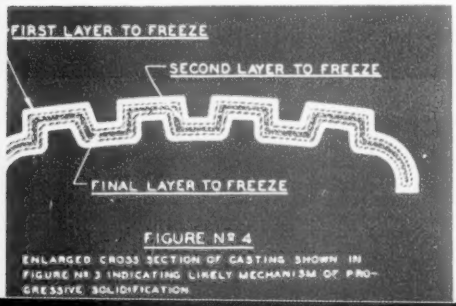


FIGURE Nº 4

ENLARGED CROSS SECTION OF CASTING SHOWN IN FIGURE Nº 3 INDICATING LIKELY MECHANISM OF PROGRESSIVE SOLIDIFICATION

Practical Versus Theoretical Shrinkage Allowance

In commercial practice, however, most die casters and die casting die makers report that in die design work they normally make a shrinkage allowance of only .005" to .006" per inch for zinc base die casting alloys. It will be noted that this "practical" shrinkage allowance for zinc alloys is somewhat less than the above "calculated" allowance of .076" for a 10" cavity or .0076" per inch.

Influence of Metal and Die Temperature

The temperature at which a casting will be formed in a die cavity will be dependent primarily upon both the initial die temperature and the temperature of the alloy being injected or cast into the die; the temperature differential between the two governing the rate of chill or cooling. The nature of the die surface (degree of polish, presence of die coating or lubricant, etc.) and magnitude of pressure on the alloy being shot into the die also affect rate of chill but are secondary factors and will not be discussed.

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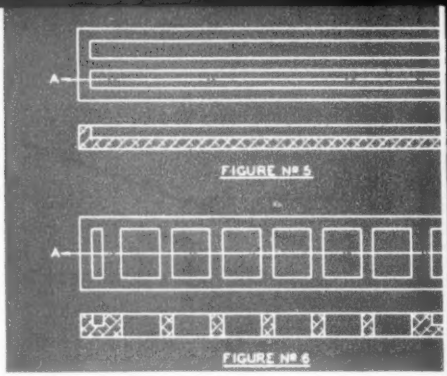

Phase Adjustment Shrinkage

In addition to the shrinkage or change in specific volume that occurs in most alloys while cooling from casting temperature to room or normal temperature, many alloys undergo further slight changes in physical dimensions as the result of phase adjustments taking place with time in the solid *after* casting.

This is particularly true of present day commercial zinc base alloy die castings which undergo a phase adjustment or shrinkage[1] of about 0.0007" per inch which is usually complete after about five weeks of aging at normal room temperature.

This shrinkage, while very small and usually of no consequence in ordinary die casting die design work, can be of importance on very long castings, e.g., thirty to seventy inches or longer, incorporating bosses or lugs that must fit into some fixed dimension within certain tolerances during subsequent assembly.

Therefore, when designing dies for long zinc base alloy die castings, consideration should be given to the possible need for increasing normal die shrinkage allowance to compensate for the phase adjustment shrinkage that takes place in the solid after casting.

This would apply particularly to the casting illustrated in Figure 3 where the

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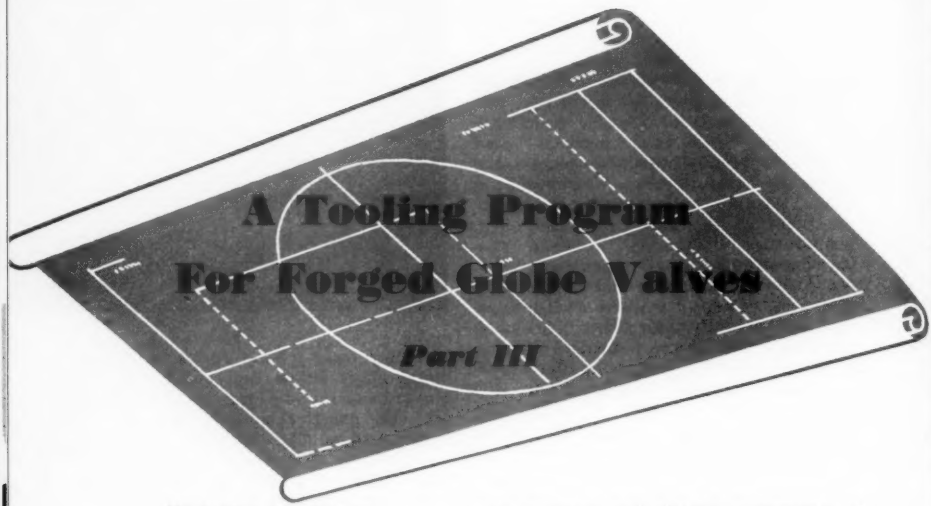
[1] *M. L. Fuller and E. L. Wilson — Trans. A.I.M.E. (1936), Vol. 122, pp. 241-243.*



A Tooling Program For Forged Globe Valves

Part III

Machining Operations

Specifications covering the Parker Offset Globe Valve are such that all machining operations must be carefully engineered so that precision production methods can be followed and customer acceptance of the finished valve insured.

One of the requirements is that the drilled holes and internal threads of the body valve port be concentric with the vertical centerline, III-B, Figure 16. This also applies to the openings, external threads and seats of the outlet ports V-A and V-C, Figure 16.

To accomplish this, the mounting bosses I-D, Figure 16, have been chosen as the starting points. The precision machining and drilling of the mounting holes in these bosses control the accuracy of the subsequent machining operations, since the valve body is mounted on locator pins in the machining fixtures by means of these drilled holes in the mounting bosses, II-E, Figure 16.

Milling the top surfaces of the bosses I-D, Figure 16, and shown in the fixture in Figure 17, is the first operation. The two center jaws of this fixture, T and U, Figure 17, are stationary while the two end ones, V and W, can be moved back and forth by the rotation of a screw. The cam and handle member of this fixture, Y, is attached to the screw by a swivel connection, and the revolving of handle Y rotates the screw. Thus the opening and closing movements of jaws V and W are accomplished. When clamping a workpiece in the fixture, the handle Y is rotated until the jaws contact the workpiece and the extra pressure required for final clamping is obtained by the action of the cam when the handle is forced in a downward direction. This method of obtaining the extra final clamping pressure replaces the conventional star knob which requires additional physical exertion on the part of the operator.

by Carl F. Benner
Assistant Editor

Adjustable buttons are installed in this fixture. Three in the left-hand side F, Figure 17, so positioned that the lower flat side of each hex rests on one, and a point of the body rests on the third. Three are also located in the right-hand side G, Figure 17, so that the machined surfaces of the bosses rest on two, and a point of the body on the third.

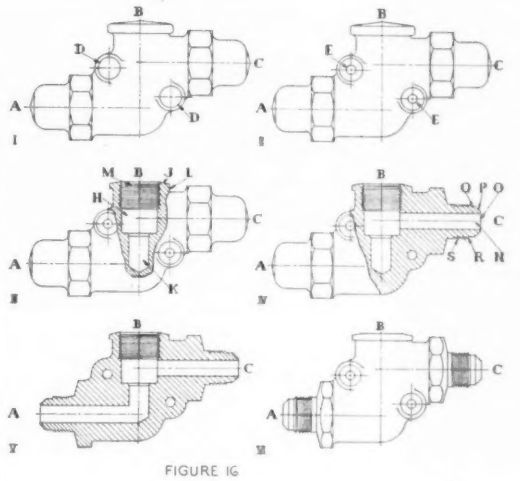


FIGURE 16

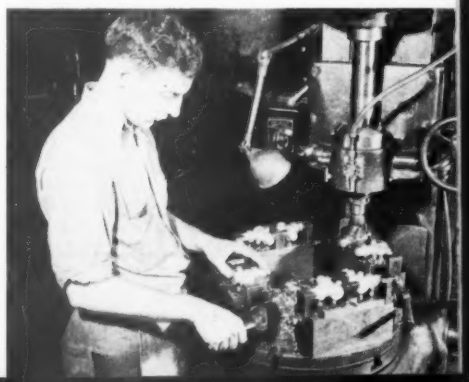
Fig. 16. Six views of the forged brass offset valve body, showing the various steps in the machining program. Cross hatched sections indicate completed machining. I, first operation, milling surfaces of mounting bosses; II, second operation, drilling holes in mounting bosses; III, third operation, drilling holes of two diameters, facing, turning and internal threading of valve port; IV, fourth operation, drilling, facing, turning and external threading of outlet port, C; V, fifth operation, fourth operation is repeated on outlet port, A; VI, valve body machining completed.

In Figure 17 is shown the holding fixture with two valve bodies, Z-1 and Z-2 clamped in place ready for the milling operations. The milling of the bosses D, Figure 17, is performed on a No. 3 Brown & Sharpe or Sundstrand vertical milling machine equipped with a power rotary table. The 1725 rpm speed of the driving motor for this table is reduced through a gear box to .45 rpm table speed. Four of the fixtures shown in Figure 17 are mounted on the rotary table so that the bosses, D, of the valve bodies travel on a 17-inch maximum diameter circle.

Figure 17-a pictures a Brown & Sharpe No. 3 verticle milling machine equipped with a power rotary table on which four milling fixtures are mounted.

The flat surfaces on all of the mounting bosses, D, Figure 17, have to be milled, and the dimensions between these opposing surfaces, D to G, have to be held to a close tolerance. To accomplish this the procedure is as follows: At the beginning of a new job, the operator loads only the left-hand side, or first station, Z-1, Figure 17, of each of the four fixtures, with a valve body as the table slowly rotates past him. As the first body loaded in the fixture travels its circuit, it passes under the milling cutter and the top surfaces of the two mounting bosses are milled. As it moves around to the operator he releases the clamps, V and W, Figure 17, by raising and turning Y one or two revolutions, and reclamps the workpiece in the right-hand side of the fixture, or second station, Z-2, Figure 17, with the unmilled sides of the bosses turned up, puts another valve body in the first station,

Fig. 17-a. Four milling fixtures set up on a rotary table operating on a Brown and Sharpe No. 3 Vertical Mill.



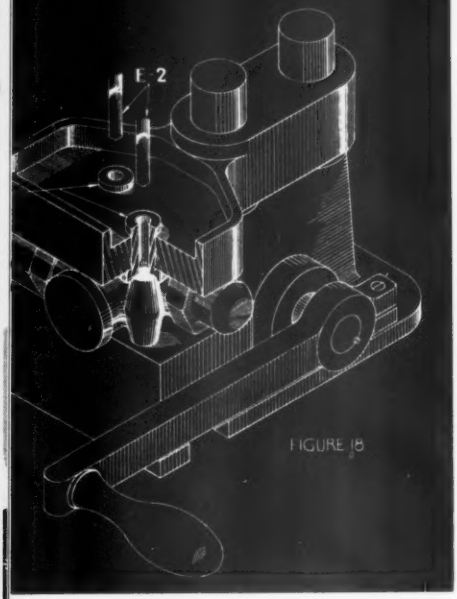


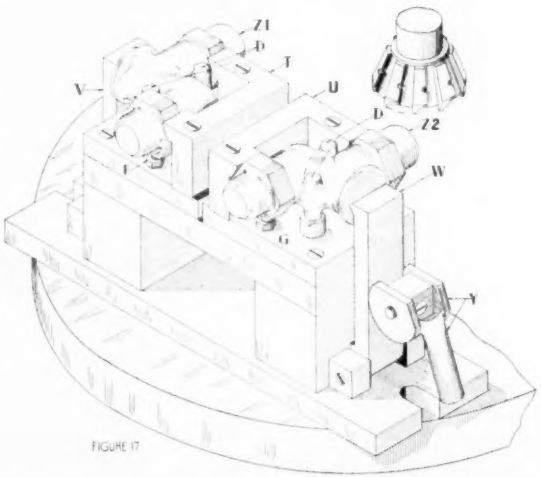
Fig. 18. Pump jig with drill bushing and gun type drills indicated. A valve body is shown clamped in the jig.

Z-1, Figure 17, and tightens the clamps, V and W.

Thus the milling cycle after all stations are filled is: Unclamp fixture, remove milled valve body from second station; remove valve body from first station; turn it over, and place in second station; place new valve body in first station; and tighten clamps V and W, Figure 17. The cutting speed of the milling operation is 24.03 inches per minute.

Because these bodies are forgings, the mounting bosses have about $\frac{1}{8}$" of excess material to be removed by milling. The locating buttons in the base of the first station, F, are adjusted to a height which will permit about $\frac{1}{16}$" of material to be removed. The locating buttons in the second station, G, are so adjusted that when the milling operations are completed on both sides, the centerline of the outlet ports is equi-distant from the two milled surfaces of the bosses. Also, this method of positioning the valve body in the fixture insures that the dimension from surface to surface of the bosses will be held to the tolerance specified.

Fig. 17. Two valve bodies clamped in a milling fixture as set up for milling the mounting bosses, D. On completion of the milling cycle, body Z-1 is removed from the first station, turned over and clamped in the second station, Z-2, for completion of milling the bosses on both sides of the body. Clamping is facilitated by the cam and handle member, Y.



Drilling Holes in Mounting Bosses

Extreme care has been taken in designing the jigs for drilling the holes in the mounting bosses, because these two holes are used in locating the valve bodies in the holding fixtures for subsequent machining operations. The pump-type jig used on this operation is shown in Figure 18. The base and handle are standard purchasable items. However, an interfering button is added to the flat base so that all valve bodies will be placed in the jig in the same position. For all intents and purposes it would not seem to make any difference from which side of the body the drilling of these holes be started. But from experience, Parker engineers have found that a slight runout of the drill will materially affect the locating of the valve body in subsequent machining fixtures, where the holes in the bosses are used with locating pins. Therefore, the interfering button prevents the valve body from being placed in the jig in any but the correct position, which is to start all holes from the same side of the valve body, that being the side from which the locating pins in the machining fixtures enter the holes in the bosses.

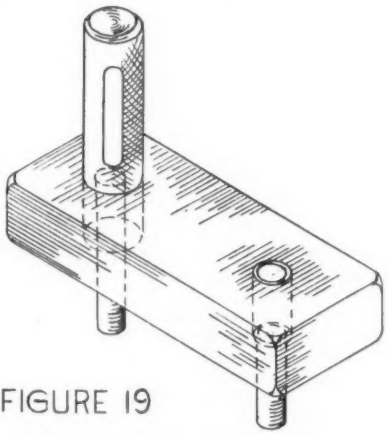


Fig. 19. Spacing and diameters of the holes drilled in the mounting bosses must be held to a close tolerance. To check these two dimensions this gage is used.

Fig. 18-a. Allen drill press equipped with a Buhr attachment for multiple drilling. The setup shows two gun type drills for simultaneous drilling. It will be noticed that the jig is opened by a lever type handle rather than the crank shown in the drawing, Figure 18.

The top plate of the jig shown in Figure 18 has two drill bushings, E-1 inserted. The bottom ends of these bushings are tapered 30° on the inside to take the tapered shape of the mounting bosses and at the same time accurately locate the valve body in the jig, so that when the holes are drilled they will be perpendicular to the horizontal plane passing through the center of the valve body. The drill bushings are made from tool steel, hardened to Rockwell "C" 62-64.

The gun type of drill is used, E-2, Figure 18. This type of drill is used because it cuts well in drilling deep holes, has a reamer action, and gives a reamer finish, thus saving a reaming operation.

The drilling operation is performed on an Allen drill equipped with a Buhr multi-drill attachment which operates two spindles, thus two holes are drilled in one operation. Figure 18-a shows an

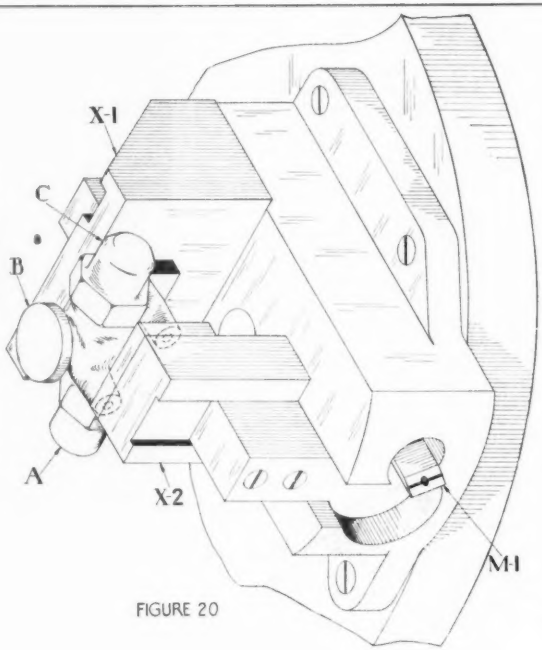


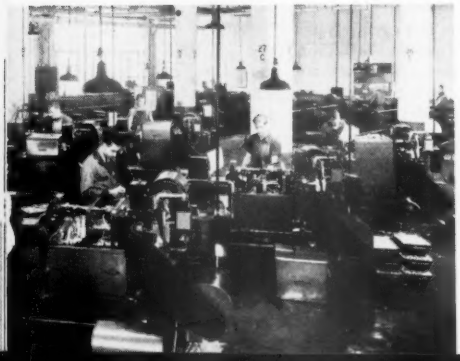
Fig. 20. Valve body mounted in a Goss & DeLeeuw Chuck, positioned for the machining of the valve port, B. The X-1 pad is stationary, being bolted to the base of the chuck. Pad X-2 is bolted to the jaw of the chuck and moves in and out by rotation of screw M-1. The four tools used in this operation are indicated.

FIGURE 20

Allen drill on which a Buhr attachment is mounted.

Because these holes are used for locating the valve body in holding fixtures for other machining operations it is necessary that they be correctly spaced. Therefore, the gage shown in Figure 19 is used to gage both hole diameter and spacing.

Fig. 20-a. Goss & DeLeeuw Automatic Chucking Machine Department.



Machining Operations on Valve and Outlet Ports

There are three sets of machining operations performed on the offset valve body in which the Goss & DeLeeuw automatic chucking machine is used.

Because dimensions have not been shown on the drawings and the size of the valve has not entered into this discussion, any mention of drill or tool sizes is used only as relative comparisons, indicating different operations as taking place.

(TO BE CONTINUED)

An Electronic Aid In Die Making

A new development in duplicator control methods and accessory equipment is being employed in the shops of the Pioneer Mold Company of Cleveland. One of the country's leading producers of precision molds and dies for the plastics molding and die casting industries, the Pioneer Mold Company is well equipped with standard duplicating equipment, Gorton, Bridgeport, Turchan, etc.

Although all of this diversified equipment is kept constantly busy on a great variety of jobs, Pioneer Mold Company engineers and toolmakers overlook no bets that show possibility of simplifying operations or improving mold-making methods.

The new method under discussion is embodied in equipment and material developed by the Mealey Grease and Oil Company, also of Cleveland. The equipment, known as the Contour Following Signal Device, and the material, an electro-conductive coating, termed "Signa-Kote," that is appiled to the non-conducting surface of a master mold or pattern, are used in combination on those types of duplicating jobs where heretofore the old stand-by tin foil method was common practice.

A better understanding and appreciation of the new method can be had by a description of the old tin foil technique and its shortcomings.

When a die or mold cavity is to be produced or duplicated, by milling, from a master pattern, means must be provided to insure that the path of the milling cutter results from, and is in exact duplication of, the master pattern profile. This is most commonly effected by a tracer point or stylus, operating in fixed relationship to the cutting tool.

The contacting portion of the stylus must be of the same shape and dimension as the cutter, and whenever, for the purpose of routing out intricate shapes and designs, the cutting tool is changed, a correspondingly shaped stylus must be chosen for that portion of the job.

As a vertical spindle, end-milling cutter feeds down into the work, tool steel die block or mold, it removes metal until its downward feed is stopped by the contact of the tracer stylus with the surface of the master pattern. Both the work and master model or pattern are located on the machine table, and as the table's feeds (longitudinal and transverse) are manipulated between the repetitive downward passes of the cutter, metal is removed until the remaining (uncut) surface is an exact duplicate of the master surface which has been similarly and repetitively contacted by the downward moving tracer stylus.

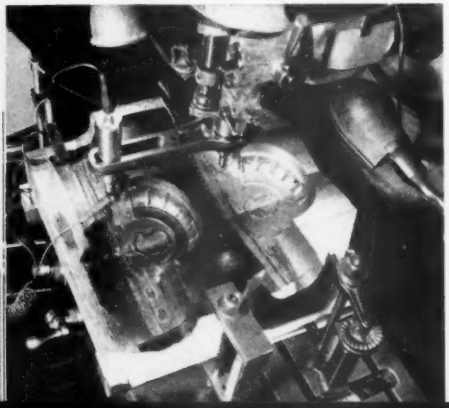
The cutter and stylus are maintained mechanically in fixed relationship, one to the other, so that the cutter can be fed into the work only until the tracer has made contact with the pattern. In those cases of manual operation of cutter and work feeds, the operator must be alert to cease feeding the instant the stylus contacts the master surface. To aid the operator's sensitivity in manipulating (or ceasing to manipulate) the critical feeds calls for a positive signalling means.

Master patterns or models may be constructed of metal, wood, plastics or plaster compositions. With metal patterns it is relatively simple to rig up an electric warning signal to indicate to the operator the moment of initial contact of the master pattern surface by the

tracer stylus; whereupon he immediately stops the cutting feed. The metal master and stylus serve as part of an open electrical circuit. When the stylus contacts the master surface, the circuit is closed, and a bell, buzzer or light gives the warning signal. If the feed is maintained even momentarily beyond the instant of contact, the consequent flexure of the stylus due to side thrust of longitudinal or transverse feed, or any indentation of the pattern surface by the stylus due to continued down-feed, will result in just that much "over travel" by the cutter, and the work becomes oversize. Hence the need for skill and alertness on the part of the operator and for a positive and infallible warning signal.

The advent of more master models made of wood, plaster compositions or cast resins, which are electrical non-conductors, has been responsible for the development of the tin foil technique. In these instances, in order that the master may be part of an electrical circuit, a coating of tin foil is applied to that portion of the surface to be duplicated. This, at best, is a fussy, messy and thankless job. Tin foil is not the easiest material in the world to manipulate. It tears and wrinkles with the greatest of ease, and by the time an irregular surface made up of intricate embossed patterns is smoothly and uniformly covered with tin foil by means of an adhesive, the cost of the operation and the disposition of the worker have both become out of line.

Fig. 1. The plaster master model has been painted over with the electrically conductive "Signa-Kote." This enables the surface to serve as part of the circuit which is completed by contact of the tracer stylus on the model. The Contour Following Signal Device is seen in the upper left corner of the view.



Once accomplished, however, the job is still far from satisfactory; the layer of tin foil is delicate and has to be treated accordingly; it is subject to abrasion and tearing by the tracer stylus; and furthermore, when subject to the make and break of the electrical current which actuates the warning signal (bell, buzzer or light of relatively low voltage and high amperage) the minute spark or arc, that occurs as the stylus contacts the foil, can puncture or burn the foil. For all of these reasons the tin foil coating is mechanically and electrically unsatisfactory and of too short life, particularly for the repetitive use of one master without recoating.

The Mealey method and equipment does away with all such handicaps. It is fast-working as to preparation and application and it is positive and foolproof in performance over long periods of time.

In Figure 1 is shown a die casting die job being run on one of Pioneer Mold Company's Brigeport turret-head milling machines; one die section of an automotive decorative grill. The tool steel block, with the die cavity almost fully roughed-out, is under the cutter spindle and the plaster master model is to the left and under the tracer arm and stylus. Instead of employing a layer of tin foil, the master model surface has been painted over with the "Signa-Kote" conductive coating which is a part of the Mealey method. The coating is easily and quickly applied by brushing and its electrical conductivity becomes a permanent characteristic of the model surface.

In the upper left-hand corner of Figure 1 may be seen the Mealey Contour Following Signal Device. This is a vacuum tube, audio signal generator, amplifier and loudspeaker. The operation of the unit is just as simple as its one on-and-off switch, tone control, and extension cord for plugging into any 110v., 60-cycle outlet, for power supply. In the

end of the unit housing is a telephone-type, plug-in jack which enables the operator to plug in a set of headphones if he is working under conditions of an extremely high shop noise level.

Figure 1 clearly shows the working connections of the Contour Following Signal Device as applied to a Bridgeport mill. Two flexible leads from the unit are clamped by means of terminal clips, to (1) any part of the machine as a "ground," and (2) to the tracer stylus. The only precaution in the whole setup is that the tracer stylus proper must be insulated from the rest of the tracer housing and equipment. This was easily done in the Pioneer Mold shop by reboring the standard Bridgeport stylus-holding quill to a slightly larger size and by using a stylus with a shank smaller than standard. The resultant difference in bore diameter and shank diameter permitted pressing onto the stylus shank an insulating bushing that fits the rebored quill. The only requirements for this bushing are that it do its insulating job and that it have sufficient wall thickness to "take" the set screw in the tracer quill.

The signal current circuit in Figure 1 is as follows: from the Contour Following Signal Device to the Bridgeport via the wire which is clipped to the top of the tracer quill housing; through the machine to the table and from the table through the work-holding clamps to the "Signa-Kote" painted surface of the master model; and then back to the signal generator via the wire which is clipped to the stylus.

The warning signal or tone generated by the device is variable by means of the tone control knob from a low to high pitch, in accordance with the operator's choice and for most effective acoustical contrast with surrounding, extraneous shop noises.

A working setup is shown in Figure 2, where the operator is hand-feeding the cutter down into the work. At the same time, the stylus goes down equally because of being carried by the extension arm which is clamped around the cutter spindle quill. The instant the stylus contacts the conducting surface the circuit is completed, and upon hearing the loud-speaker signal, the operator stops his down-feed. He then in-feeds the table a few thousandths and repeats the milling cut.

While thus "jogging" both the table transverse and longitudinal feeds between cuts so that finally the tracer has reached down to and contacted the entire varying profile of the master, the cutter, meanwhile, due to its successive down-feeds, has removed metal from the die block to the extent that the die cavity has become an exact replica of the model cavity.

It will be noticed in Figure 2 that one of the signal device terminals is clipped to a clamp which, in turn, overlaps a portion of the coated surface of the master. This "ground" terminal can be clipped anywhere on the setup that insures an uninterrupted electrical path from the surface coating back to the signal unit.

The setup shown in Figure 3 is of

Fig. 2. The operator down-feeds the cutter into the work until he hears the contact warning from the loudspeaker of the Contour Following Signal Device. Located below the speaker opening is the tone control which enables the operator to adjust the pitch of the warning signal to most effectively contrast with surrounding shop noises. Latest models of the signal are being equipped with a red pilot light as an indicator that the current is on.

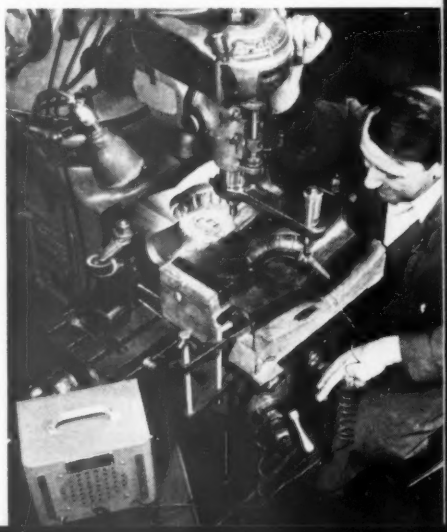


Fig. 3. A hook-up of two Contour Following Signal Devices giving control of milling in two directions. The outfit nearest the operator controls the vertical feed and the other is set to govern the width of the shoulder being milled.

particular interest, because it shows an ingenious application of two of the Contour Following Signal Devices to the control of cutting feeds in two directions. The job is that of milling the shoulder, seen in the path of the cutter, at the top rear of the die member.

The vertical depth to which the shoulder is milled is controlled by the tracer stylus and signal circuit operating on the master model. In this instance, for dimensional reasons, the stylus is held in an extension piece bolted to the regular Bridgeport arm that extends from the spindle quill.

At the rear, operating on the die block proper, is another tracer and signal circuit which controls the horizontal width to which the shoulder is being milled. The bent rod that supports the tracer is secured by the hole and set screw that show in Figure 1 as a part of the quill housing, below, and to the left of the spindle down-feed lever, and just to the right of the quill locking lever. On and near the outer end of this bent rod is a universal clamp or adaptor holding a shorter rod that serves as the stylus and which can be seen pointed toward the vertical face of the die block.

The distance that exists (by projection) between the end of the tracer rod and the front side of the end-mill determines the width to which the shoulder is to be milled. As the table is fed inward the width of the shoulder increases, until the rear tracer contacts the face of the die block, whereupon the loudspeaker signals the operator that dimension has been attained. To repeat, the width of shoulder, or distance between the two vertical planes defining the shoulder, is the dimension set up between the end of the tracer and (by projection) the far side, or most advanced point of tangency, of the end-mill.

In this application the tone controls of the two Contour Following Signal Devices are set, one sufficiently higher in pitch than the other, so that the operator instantly recognizes a signal as being either the in-feed warning or the down-feed signal.

Because the signal generator is an electronic tube, grid circuit triggered device, the actuating current flowing through the flexible leads, the machine and the model surface are so weak that there is no danger of shock or fire. An accidental "short" in the control circuit would only cause a continuous signal, calling for remedial action.

The setup of Figure 3 is indicative of the versatility of the Mealey method. It is easy to visualize a hook-up whereby three signal circuits could control the three dimensions of a slot or rectangular cavity, length, width and depth.

The full range of applicability of this electronic tool is limited only by the variety of jobs going through a shop and the ingenuity of the users.

Additional information as to specifications and applications of the Mealey Contour Following Signal Device may be had by addressing the Mealey Grease & Oil Company, 2945 E. 83rd Street, Cleveland 4, Ohio, or by use of our postage-free INFORM-A-GRAM Key No. K30-T.

Hydraulic Valves And Control Devices

Part II

by L. H. Schuette
Chief Production Engineer
Sundstrand Machine Tool Company
Pump Division
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In a number of cases we have been confronted with the necessity of combining a number of valve operations and arranging this combination so that manifold connections can be made to the remainder of the system. In the usual form we accordingly supply a mounting face to pull against the mating surface on the machine.

Leaks at Mating Surfaces

While we can make this mounting surface on the valve as truly flat as is necessary, there are innumerable occasions where the ultimate user does not appreciate the necessity of providing a similarly flat mating surface, with the result that when the valve is mounted, leakage is evident.

In order to eliminate this leakage, the first tendency on the part of the assembler is to tighten the mounting bolts. Unless we design these valves with an excessive amount of bulk the castings will not take the strain which can be applied in making this connection. The consequent distortion of the casting always results in "sticky" valves and overall unsatisfactory performance.

In order to meet this demand on the part of the user for valves in combination, we would like to show a few typical examples of what can be done to overcome the disadvantages outlined previously and to also provide systems which are more efficient.

Hydraulic System for Work Clamping

Assume for a moment that our problem is to provide a hydraulic system for clamping the work in a lathe. In order to open and close the chuck jaws as rapidly as possible we will want a large supply of oil available. When, however, the chuck jaws strike the material to be clamped, we no longer want capacity on the part of the pump but we merely wish pressure. To provide for this operation we would like to describe a co-ordinated system which, to a certain extent, overcomes the disadvantages of a large number of individual devices to be connected with piping and also provides for a minimum input supply to perform the functions intended. For this type of a system we would use a double pump; one having a large capacity for the quick opening and closing of the chuck jaws; and a second pump of a relatively small capacity to supply the pressure necessary to clamp the work.

In addition, we will need a 4-way valve to direct the oil to either end of the cylinder, a valve which is sensitive to the pressure in the system, and dumping valves. These are all included in the pump housing casting and interconnected with drilled or cored passages. A remote pilot valve and the operating cylinder are the only devices which are necessary to pipe.

With actuation of the remote valve,

Fig. 1. In this typical hydraulic system the fluid pressure results in a straight-line application of power due to the travel of the piston within its cylinder. Such a system would be employed for actuating a work-holding chuck. The quick-travel opening and closing of the chuck jaws is the function of the large pump. The second pump, of relatively small capacity, builds up the necessary holding pressure while the jaws are gripping the work.

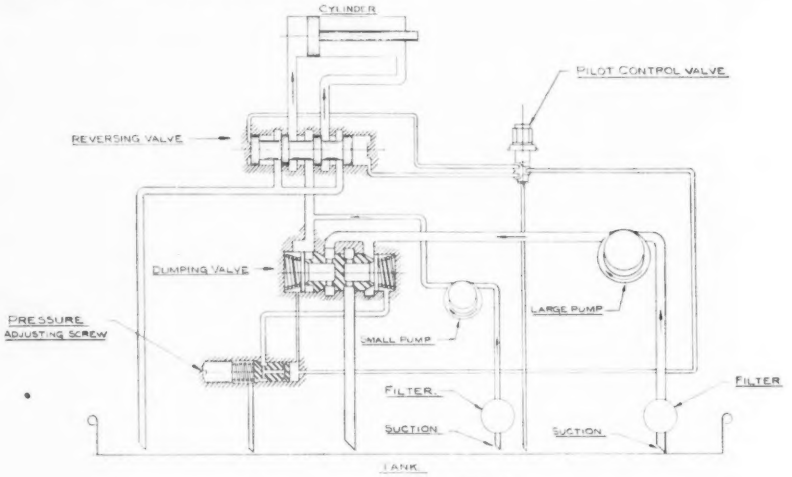


FIG. 1

which starts the cycle, the flow of oil, from both the large and small pump, is directed, by the 4-way valve, to the proper end of the cylinder. This provides for the rapid closing of the chuck jaws. Since the pressure required by the closing operation is usually much lower than the pressure required to clamp the work, the pressure-sensitive valve will block the dumping valves to prevent return of the oil to the tank. When the pressure rises, the pressure-sensitive valve, which in this case is essentially a relief valve, operates the dumping valve to dump the capacity of the large pump at a pre-set pressure but continues to direct the capacity of the small pump to the cylinder. Since its capacity is small, the overall power input to the system is held to a minimum.

When the cycle is reversed by the operation of the pilot valve, the 4-way valve reverses, the dumping valves are restored to their blocked position, since the pressure has now fallen to that required to quickly open the chuck jaws, and the large capacity of the pump is automatically brought back into the circuit.

"Requirement" Pumping

As previously discussed, the use of metering valves to obtain a variable control over the rate at which the cylinder moves requires an excess amount of power at all rates except the maximum. In instances where this is undesirable, and in order to provide a system which will eliminate, to a certain extent, the undesirability of excessive piping to the various separate functions required, we would like to call attention to a system which, for the want of a better term, we call "requirement" pumping.

Milling Machine Table Controls

The application which we will select as a typical example is the control of a table on a milling machine. Here the requirements are: first, we need a large capacity pump in order to move the table quickly from a point where a man may

load a fixture to a point where the milling operation is to begin. At this point we wish to control the rate of movement of the table so that it will move at the proper speed to produce the type of surface which is required on the piece or part which is being machined. Furthermore, approximately half way through the cut we no longer need be concerned about the type of surface, so we wish to increase the rate of feed in order to speed up the overall cycle of operation. When the actual cutting is finished, we then, of course, wish to return the table as rapidly as possible to its starting position since this is lost time so far as performing the intended function.

Here we have the necessity of providing some means of varying the rate at which oil is delivered to the cylinder during the time when work is actually being done. In order to provide all of these various functions in a unit and combine them as much as possible, we have arranged a large constant displacement pump, a smaller capacity variable displacement pump and then the valves which are necessary to control this cycle of operation. In order that we eliminate, insofar as possible, excess piping, electrical pilot operation with solenoid valves will be used.

Electrical Pilot Operation

These solenoid valves will be controlled by switches which are in turn actuated by the dog bars on the table of the milling machine. With the initial start of the cycle, which is made by the operator pushing the start button on his push button station, the 4-way valve is positioned so that it will direct the capacity of the large pump to the proper end of the cylinder. With this large capacity the cylinder will move at the desired rapid traverse rate. When the table has moved to a second pre-set position where the feed rate is to begin, a switch will

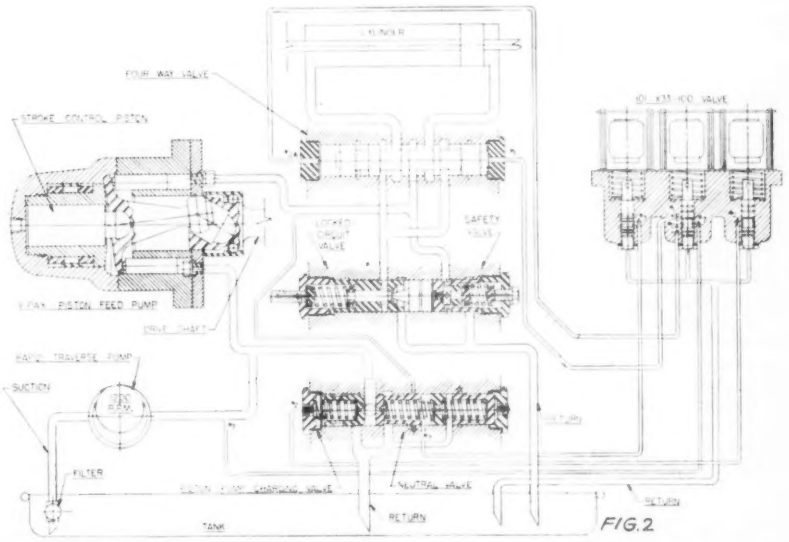


Fig. 2. This hydraulic circuit is an example of the author's description of "requirement" pumping for driving a milling machine table. Solenoid valves, actuated by dog bars along the machine table, give electrical pilot control for rapid traverse and two work feeding speeds. A further refinement is the introduction of the locked circuit valve which insures that the table will not be "carried ahead" of its drive when climb milling is being done.

connect a second solenoid valve, which in turn will dump the capacity of the large pump at a negligible pressure, and will supply this oil to the inlet of the variable displacement pump, whose stroke is controlled by, for this example, a manual adjustment. This variable pump now delivers a much smaller quantity of oil to the cylinder and the pressure in the circuit rises to a value which is sufficient to do the work at the rate intended. As will be noted, no by-passing is taking place.

In accordance with our typical example, half way through this cut the dogs on the table are so set that a third solenoid is energized, which now allows this manual setting to change to a second manual setting, increasing the stroke of the pump, thus supplying more oil to the cylinder and increasing its rate of movement. When the table has reached the desired position, as indicated by the setting of the dogs, a switch controlling a fourth solenoid valve will cause the 4-way valve to reverse, the dumping and feed valves will be restored to the original position and the capacity of the large pump will then be supplied to the other end of the cylinder, providing the rapid return rate.

Effect of Climb Milling

During the feed rate of our typical example, we find it necessary to take care of an unusual characteristic which might occur during our milling operation, particularly under what is commonly called "climb milling". Since the cutter is traveling in the same direction as the cylinder, and since it is cutting intermittently, it has a tendency to move the table independent of the oil supplied by the pump. In order to provide the rigidity required to prevent this table from moving except as governed by the feed rate of the pump, we must incorporate in this circuit a means for locking the operating piston. To acomplish this we use a locked circuit valve.

This is connected internally by means of channels in the supply and discharge ports of the main operating cylinder. The pressure required in the circuit to drive the cylinder is directed to a valve connected to the return line of that cylinder. It is designed so that for a given feed rate it will open a certain distance, permitting the oil to return from the back-side of the cylinder to the tank at a slight back pressure. If, however, the piston of the cylinder is driven or carried ahead, as in this example, by the cutter of the milling machine, the pressure in the supply circuit falls and our pressure sensitive valve acts to restrict the flow of oil from the back-side of the cylinder. The back pressure, therefore, rises and the cylinder is locked by the oil return column at the feed rate of the pump.

While we have continuously discussed the use of a cylinder in our typical examples, this cylinder can only provide for linear motions. In each case where rotational motion is desired, a hydraulic motor can be substituted for the cylinder and the identical operating characteristics obtained.

All of the systems previously discussed are somewhat limited in their overall control of the rate of operation of the operating cylinder. If we use a metering valve to control the rate of movement, excessive by-passing results. If we use a system of requirement pumping, as discussed, we gain certain advantages but do not have completely variable control over the entire operating range.

Rotary Motions

In order to meet the demands of having complete control over the rate of movement of our operating cylinder with a range of 200 or 300 to 1, and in some instances even as high as 1000 to 1, a different type of hydraulic system, commonly called the closed circuit system, is most often used.

In this type of system the motor or cylinder operates at a speed or rate which is a definite function of the quantity of oil pumped. By varying the amount of oil pumped, or by varying the rate of oil consumption by the hydraulic motor, complete control over the speed range can be obtained. The pressure in this type of system will rise and fall automatically to meet the work requirements at the output shaft of the hydraulic motor so that, within design limitations, pressure has little to do with this rate of operation. In order to do the work required at the output shaft,

to repeat again, the quantity of oil determines the speed, the torque required determines the pressure.

In accordance with our original definition, all of these devices which provide this flexibility of control are now going to be called controls, even though a number of them are essentially pilot valves regulating the flow or pressure in circuits which are auxiliary to the main transmission of power. Since this type of system is most commonly used in applications where speed is the main function to be controlled, we will assume that our typical circuit now consists of a variable displacement pump and a constant displacement hydraulic motor.

Speed or Ratio Control

For the sake of clarity we will take a few specific examples. We wish to apply hydraulics to provide a complete controllable range from a stop position to 2000 rpm. This is all to be done with the movement of a small handle which can be operated with one's finger through an angular rotation of, for example, 10 degrees. In addition, we wish to rotate this small stem 10 degrees in the opposite direction and obtain complete control while the motor is rotating in the opposite direction. In addition, for a specific amount of angular movement of the operating stem, we wish a specific speed. For this type of a control system we need a source of pressure and a pilot control, which is essentially the same as the 4-way valve previously described. This will direct the flow to the means for varying the displacement of the pump so that it pumps in one direction or pumps in the opposite direction. If only this valve were supplied, the pump immediately would assume its maximum stroke and the motor would operate at the maximum speed. Additional provision must, therefore, be made to stop this stroke at the point desired in order to limit the speed in accordance with the calibration of our operating handle.

As one example of this means, we will attach to our pilot control, or 4-way valve, a variable orifice which is operated by the movement of the stroking mechanism itself so that when the stroke reaches the position indicated by this angular movement of the stem, its pressure will automatically rise and oppose the pressure from the 4-way valve, thus holding the wobbler at this position to give the desired ouput speed. For all intents and purposes, this overall system is a velocity servo. With small fingertip control we are moving literally mountains at exactly the speed desired.

In this same system we now wish to obtain characteristics which are quite similar to those of a direct current, series wound, motor. For a given quantity of oil pumped, we wish a certain speed. However, if the load should become excessive we wish to have a speed drop and for this drop in speed we wish to obtain additional torque. In order to provide this type of control, we will take a pressure-sensitive control or valve and connect it into the main line from the variable displacement pump to the hydraulic motor which now must also be variable. When the pressure is at a low value, we will have the hydraulic motor in minimum stroke and its speed will be a function of the amount of oil pumped. As the load increases at the output shaft we have an automatic rise of pressure in the main line and this pressure-sensitive valve now readjusts the displacement of the motor. This reduces its speed and automatically, for approximately the same pressure, gives use more torque.

"Space" Servo Mechanism

As a second typical example we wish to provide a hydraulic system wherein the movement of the work is to be a definite function of the movement of the stem; i.e., if the stem moves 10 degrees the work moves 10 degrees, then stops. The work is not to move at the same rate as the movement of the stem but is merely, at some slower rate, to move to the position indicated by the initial movement of the stem.

For this system we can again use the variable displacement pump and the constant displacement motor. The controls for the stroking of the pump will differ from the case cited above only to the extent that a movable sleeve, containing ports identical to those on the stem, must be added to the pilot control. This sleeve is directly connected to the work

by gearing, for example, so that the movement of the work is fed back to the pilot control. When the stem is moved, oil is admitted to the stroking control mechanism which causes the pump to deliver oil to the motor which, in turn, drives the work. As the work moves, an indication of its movement is transmitted to the sleeve through gearing, in a direction to close the pilot valve and return the pump to "no stroke", thus stopping the work. This system is commonly called a "space" servo.

Velocity and Space Control

In the third typical example of control we now wish to have both velocity and space control. Here we will co-ordinate the elements of both systems and combine them so that we can do work at exactly the rate and with exactly the amount of power required in accordance with the demands of an original signal requiring little or no effort.

Turret Controls

During the war a typical example of this type of mechanism was a control system for turrets wherein any number of these turrets were operated to aim the guns in accordance with the demands at a sighting station. A signal was transmitted from the sighting station to the pump stroking control which provided the means by which the pump stroking mechanism adjusted itself to supply the desired rate of output speed, and this was again related back to the initial movement. "Hunting" difficulties experienced with this type of system were largely overcome so that it was able to obtain extreme accuracies. This leads us to possible discussion of the control systems of the future.

Auxiliary Electrical Controls

To a large extent, up to the present time, particularly so far as commercial applications are concerned, the only electrical mechanism which has been employed has been a solenoid valve. It has purely "on" and "off" characteristics and in a large number of cases these have been perfectly satisfactory. However, if more complete control is desirable it will be necessary to take other electrical functions and translate them into a means by which we can control, and control accurately, hydraulic transmission of power. Signals detected electrically by such devices as photo-electric cells, electrostatic pick-ups, etc., can be readily amplified and integrated to provide the desired power.

Variable Input, Constant Output

As a specific example of this accuracy of control which is possible with hydraulic mechanisms, I would like to take a few minutes to tell you of a recent development on which we have been working for the past three years and which is now going into production. This development, started during the war and which is still continuing, was to provide a means whereby alternating current could be utilized in large aircraft. The requirements of the electrical system for control of the airplane were becoming so excessive that it was no longer feasible to use the old 24-28 volt direct current system economically. After considerable analysis on the part of the engineers of the electrical industry, it was finally decided that the electrical system would be 400 cycle, 208 volt.

Since the frequency is a definite function of speed and since the frequency now is high, it was necessary to generate at a relatively high speed. In addition, since the frequency is a definite function of speed, it was not possible to operate these alternators from the aircraft engine which revolves at anything from idling to take-off speeds, roughly a range of 3½ to 4 to 1. An auxiliary power plant with its separate engine could have been supplied but it had many inherent drawbacks.

The main problem, therefore, presented to us was the requirement of taking the variable speed from the aircraft engine and providing a controllable constant speed for the generation of alternating current. The input speeds selected were 2100 to 9000 rpm and the output speed for generation was 6000 rpm. This system was to be controlled with an accuracy which would permit synchronization, parallel operation of any number of alternators, and an equal division of the electrical load when more than one alternator is operated in the electrical circuit.

Here we have a typical example of being required to take a measure of the frequency of the electrical circuit and the current which is delivered from each alternator and translating and integrating these two signals to control a hydraulic drive with extreme accuracy. The hydraulic unit which we selected for this application consists essentially of a hydraulic differential system wherein the difference between the input and output speed is performed by hydraulic action; i.e., pumping and motoring. Stripped to its barest elements, the unit is a variable displacement hydraulic pump and a constant displacement hydraulic motor, so arranged that the input shaft rotates the pump and motor cylinder block assembly. The output shaft is free to rotate as dictated by the action of the hydraulic motor pistons. The stroking means is stationary with respect to the case of the drive.

When the pump is in a "no stroke" position, which in this case becomes direct drive, the closed circuit hydraulic system requires the motor pistons to remain stationary and they, in turn, drive the output shaft. If the input speed is lower than the required 6000 rpm output speed, the wobbler is tilted and the motor pistons now reciprocate and add to the base input speed the necessary speed to obtain the 6000 rpm at the output shaft. If the input speed is higher than the desired output speed, the wobbler is rotated in the opposite direction and the action of the motor pistons is to subtract from the basic speed to again re-establish the desired output speed. All of the control functions center on the means which controls the stroke of the hydraulic pump.

The output shaft of the hydraulic mechanism drives an electric tachometer generator, the voltage of which can be made a function of output speed. In addition, from one of the electrical lines from the generator we take a signal, by means of a current transformer, of the amount of current being transmitted from the generator. Through a system of rectification these two signals are integrated and the final resultant voltage is transmitted to what, to all appearances, looks like an ordinary solenoid valve.

Variable Solenoid Valve

As we previously mentioned, a solenoid valve usually had nothing but "on" and "off" characteristics. However, by using a solenoid with a tapered air-gap, a pilot valve stem similar to that used in the 4-way valve, and a spring, a suitable means of control was obtainable.

The valve stem was balanced in its mid-position against the force of the solenoid by means of a biasing spring. A momentary change in current to the solenoid because of a momentary change in output speed resulted in temporary unbalance and oil was allowed to flow to the servo mechanism controlling the stroke of the pump until the condition was corrected.

In conclusion, some of the design data for this servo control mechanism on the transmission just described, delivering 75 hp at 6000 rpm, with input speed of 2100 to 9000 rpm, illustrates quite clearly the possibilities of controlling accurately the transmission of power by hydraulic mechanisms. The travel of the pilot stem was .010". The maximum solenoid force was 1½ pounds, and the auxiliary pressure for the servo was 250 psi on a piston having a 1¼" diameter.

EDITOR'S BLUEPRINT FOR FEBRUARY

Centralizing or Justifying Fixtures
—in precision work these spotting or lay-out fixtures are used to determine that all machining on a casting or forging will be correctly located overall.

Light-weight Fixtures
—the use of light metal alloys in fixture construction to lessen the handling load on the operator.

Circular Relief Tool Grinding
—the geometry of circular or eccentric relief of a cutting tooth. Equipment and setups for grinding circular relief.

Radio-frequency Heat Treating
—applications of the principles of Induction and Dielectric heating to cutter teeth, shaft hardening, production brazing and non-conductive workpieces.

Tooling Shortcuts
—an emergency punch and die made from hollow head screw and wrench.
—built-in indicator buttons for alignment of milling fixtures.

Continuing Features
A Tooling Program for Forged Globe Valves.
Hydraulic Applications from the Users' Viewpoint.

Demonstrating And Reporting Quality Control*

by Martin A. Brumbaugh
Professor of Statistics
University of Buffalo

This subject presupposes that a quality control operator has been at work in a plant and has obtained some results that are worth reporting. In making such a report he must recognize that there exists: (1) a great variety of types of plant operations, (2) a great variety of points of view of quality control operators, and (3) a great variety of attitudes of management. Each of these factors must be taken into account in planning a reporting program. Accordingly, what follows here must be interpreted in terms of conditions existing in a particular plant. In general, a quality control operator earns his salary by possessing two types of ability: (a) knowledge of where to find things in a book, and (b) an intuitive sense as to when to abandon the book in favor of his own ingenuity.

The operator who is in the fortunate position of working with management that understands the technique of statistical control, can report in detail everything that he is doing. In fact, keeping management fully informed is the best method of maintaining interest in the work. Even under such favorable conditions, summary reports should be submitted at strategic times.

If management is open-minded but uninformed on statistical control, the first requirement is to do some sugar-coated instructing in the subject. But the exact procedure must be geared to the personalities involved, both management and operator. The author has witnessed the successful use of three entirely different techniques. There must be others that have been used with equal success:

(1) The probability approach: set up examples with cards, dice or colored beads to show chance variability; plan the experiments so that they will be applicable to the plant's manufacturing operations.

(2) The control chart approach: tell the story of separating chance variability from assignable causes of variability; show the frequency distribution analysis and application to plant operations; present the principles of sampling, preferably with examples of potential or actual savings.

(3) The indirect approach: forget statistical control and tell the story solely in terms of operations and results obtained; bring in the control chart as an operating device, and keep the statistical background out of the presentation.

If management is only luke-warm or even hostile, great care is required. Believing that this case requires the greatest amount of discussion, two cases are

*This paper, under the title of "Reporting Quality Results to Management", was read before the Midwest Conference of the American Society of Quality Control. It is presented here by courtesy of the author, who is also Editor of the Society's "Industrial Quality Control".

TABLE I

Man-Hours Per Unit in Assembly
Before and After Using Statistical Control

Item	November December January (Man-hours per unit)	February March April (Man-hours per unit)
Assembly	3240	3328
Inspection	733	766
Repair and Replacement	1209	405
Reinspection	290	56
Total	5472	4555
No. of Units Accepted by Army	367	508

***Table I.** Showing a comparison of the man-hours per unit in assembly, inspection, repair and replacement, and reinspection, before and after using statistical control. Shown also are the Army acceptance figures for the two periods.*

presented in the sequel in which quality control operators succeeded in converting hostile managements.

Case I

The quality control engineer operated two levels below the quality manager who reported directly to the plant superintendent, the responsible policy-making executive. Initially the quality control engineer was authorized by his supervisor to analyze records of inspection of assembly operations. The engineer prepared charts of number of defects per unit and posted them at all assembly stations. Simultaneously he inaugurated a system of weekly reports. These reports were circulated to foremen of inspection and production as well as to the quality manager and the plant superintendent. There was no evidence that the executive paid the slightest attention, but the quality of assembly work improved steadily.

At the end of three months the engineer submitted a report which included Table I and compared the man-hours per unit in assembly, inspection, repair and replacement, and reinspection before and after using statistical control. Included also was a comparison of the number of units accepted by the Army in the two periods. The marked improvements indicated by this table finally drew the plant superintendent's attention, and he ordered an expansion of the statistical department with instructions to investigate fabrication operation and receiving inspection.

The machine shop, although producing 400,000 piece parts per week, was characterized by short runs, sometimes making as many as 800 different part numbers in one week. Control chart analysis of an operation of this type was not attempted, even though the initial record of 15% reworked and 4% scrapped indicated plenty of room for improvement. Instead, a weekly report of the form shown in Table II was circulated to management and to shop supervision.

This report gave a record of the quality of production in the machine shop, showing the number and percent of pieces accepted and rejected for both the current week and for the preceding ten weeks. The report also included an analysis of rejected pieces, showing cause of rejection, rework data, and scrap loss.

Just as in the assembly area, this report received scant attention and for several weeks no improvement was shown. A chronic rework was defined as an item for which at least 10% of production was returned to the machine shop for at least three successive weeks.

This supplementary information finally caught the eye of the plant superintendent and action followed quickly. Individual foremen were called in for specific explanations. The usual attempt to "pass-the-buck" was stopped short by the detailed inspection records presented by the control engineer. Corrective action was swift and permanent. The results after seven months of reporting are apparent in Table II.

A report to the plant superintendent stressed the fact that in 1944 one piece out of six passing through the shop and passing to the inspection bench was covering the route a second time. Stated differently, this meant that one-sixth of the machine capacity of the shop was ineffective and that inspection costs were inflated by 20%. This situation was automatically corrected by the reduction in reworks in 1945. This report was made to offset the shop supervision contention that reworks were inexpensive.

A parallel reporting procedure was set up for receiving inspection, but its effect was negligible until the control engineer prepared a vendor rating sheet, Table III, and submitted it to the purchasing department. This sheet showed the average percent defective of inspected samples or lots for each individual part number supplied by the respective vendors. The first one was made for a list of standard parts. Subsequent ones were made for the list of special parts

Table II. Progress made over a seven-month period after effecting quality control. This report demonstrated that in 1944 one piece out of six passing through the shop and on to the inspection bench was covering the route a second time. In other words, one-sixth of the machine capacity of the shop was ineffective and inspection costs were 20% inflated.

TABLE II

Quality of Production in Machine Shop
Before and After Corrective Action

Status	Number of Pieces Through Inspection Week Ending		Percent of Total Pieces Inspected Week Ending		Average Percent for Previous 10 Weeks Week Ending	
	August 19, 1944	March 24, 1945	August 19, 1944	March 24, 1945	August 19, 1944	March 24, 1945
Accepted As Is	332,518	218,706	83.7	97.1	85.2	97.5
Not Accepted As Is	64,757	6,474	16.3	2.9	14.8	2.5
Total	397,275	225,180				

Analysis of Rejected Pieces

Returned to Machine Shop for	Number of Pieces Week Ending		Percent of Total Pieces Inspected Week Ending	
	Aug. 19, 1944	Mar. 24, 1945	Aug. 19, 1944	Mar. 24, 1945
Operations Omitted	23,320	712	5.62	.32
Rework Dimensions	15,338	1,562	3.86	.69
Burrs	10,159	46	2.53	.02
Rechase Threads	8,311	132	2.09	.06
Strip Chrome	1,182	496	.30	.22
Heat Treat	1,343	18	.34	.01
Miscellaneous	714	538	.18	.24
Scrapped	15,230	2,998	3.83	1.33
Total	75,597*	6,502		

**Higher total due to multiple defects.*

TABLE III

Vendor Rating Sheet

Average Percent Defective of Inspected Samples or Lots

MONTH

NAME OF VENDOR	PART NUMBER					
	1	2	3	4	5	6
A		.02		.02	0	
B						.05
C	.08	0	.03			.01
D				.11		0
E			.03	.04		
F		.10		.07		

Table III. A reporting procedure paralleling that used in compiling Table II was of negligible effect until the control engineer prepared the above vendor rating sheet and submitted it to the purchasing department. On the basis of this report, the purchasing department rearranged its contracts to procure from each vendor those parts in which that vendor excelled. Vendors with uniformly poor quality records were dropped.

going into a single sub-assembly. Purchasing discovered the parts for which a particular vendor could maintain good quality, as well as the vendor or vendors that could maintain good quality on a particular part number. A supplementary sheet, showing the number of rejected lots during the month returned to each vendor, quickly revealed the source of most of the costly follow-up work of the purchasing department. On the basis of this rating sheet the purchasing department rearranged its contracts, assigning to each vendor the part numbers which that vendor could do best. A few vendors with uniformly poor quality records were dropped. The effect of this rearrangement was apparent on the rating sheets of subsequent months.

The reports described are only a sample of the work done by this control engineer. He adhered to the point of view that corrective action should be the responsibility of production, but that it was his task to provide as much detailed information as possible to aid production. He made no spectacular attempts to attract the attention of top management, but rather depended upon the cumulative effect of repetitive reporting. He did come to three conclusions: (1) immediate superiors, with no knowledge of quality control procedure and no desire to acquire such knowledge, are a hindrance to progress, despite good intentions, (2) top management must possess some knowledge of quality control procedure and a genuine interest in using control results as a management tool, if the work of the control engineer is to be effective, (3) there is no method of evaluating or reporting the intangible gains from the use of statistical control; hence evaluated dollar savings are always an underestimate of the benefits of a control system.

Case II

The chief inspector of this plant reported directly to the factory manager and within his own function possessed sufficient authority to introduce statistical control procedure as an integral part of inspection operations. This was done initially in the assembly area because this plant does comparatively little fabrication, although many special parts are machined in the plant.

Over a span of three months considerable improvement in assembly operations resulted from daily and weekly reporting of the results of inspection. When out-of-control conditions were encountered, immediate investigation followed. In some cases this led directly to receiving inspection. Detection of quality variation there led in several cases to the dispatch of trouble shooters to plants of

TABLE IV

Status of Assembly Operations After Three Months of Corrective Action Based on Control Chart Records

Assembly Operation	Percent Defective				Percent Improvement in Three Months
	At Start of Program	One Month Later	Two Months Later	Three Months Later	
A	6.2	5.1	4.1	2.3	63
B	36.0	22.9	13.5	10.4	71
C	11.2	6.6	4.9	1.7	85
D	10.7	8.2	3.4	2.5	77
E	69.6	65.8	61.5	45.8	34
F	18.8	12.3	11.3	10.6	44
G	6.3	4.2	2.6	1.5	76
H	7.2	5.1	3.9	2.9	60
I	15.3	9.7	5.2	4.6	70
J	10.1	3.5	2.7	1.6	84
K	26.9	16.1	12.7	9.1	66
L	2.7	1.1	.3	.4	85

Table IV. Daily and weekly reporting of the results of inspection permits immediate investigation of out-of-control conditions. This summary showed the steady and striking improvement in percent defective in assembly operations resulting from three months of corrective action based on control chart records.

vendors. In other cases assembly failures were quickly traceable to faulty machine shop operations. In still other cases it was found that piece parts and subassemblies were being damaged during assembly. In a few cases blueprints were changed on the basis of the control chart records. Corrective action produced results which were recognized by operating supervision throughout the plant, but top management gave no evidence of being aware of the existence of the quality control system until the chief inspector prepared a summary, in the form shown in Table IV, which showed steady improvement in percent defective in assembly operations during the first three months of corrective action based on control chart records.

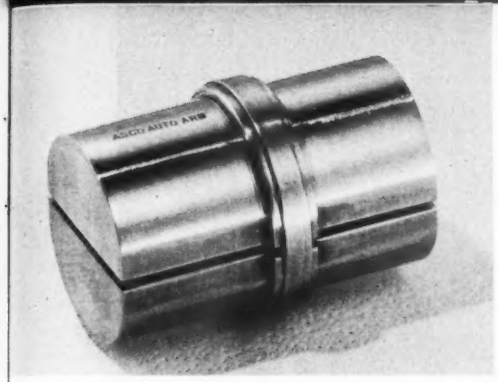
This report produced ample response from top management, and the chief inspector was authorized to install statistical control of all operations in the plant. The chief inspector is very meticulous about placing on the president's desk periodic summary reports of the quality status of all operations.

In passing, several other experiences can be mentioned briefly. A quality manager planning the introduction of statistical control "sold" the idea to top management and secured a general directive authorizing him to install his system. He then began issuing orders to operating departments, but did not train men in his own inspection department in control chart technique or corrective action procedure. Needless to add that the results were disastrous. This man was shortly transferred to another plant and soon left the company.

In another plant a new vice-president in charge of plant operations announced that all emphasis must be placed on two departments, production and selling. Pursuant of this plan, the inspection department was skeletonized and a flourishing statistical control installation was abandoned. Three months of this policy has resulted in the loss of a long standing contract to make an important

(CONTINUED ON PAGE 98F)

ASCO "AUTO-ARB" can triple production on many secondary operations



Automatically Expanding Arbor for holding work piece by inside diameter while machining outside surface.

Permits Chucking and Unchucking *Without Stopping Spindle!*

Any machinable part of metal, plastics, wood, etc., can be held firmly by the inside diameter, for secondary operations, with the ASCO "AUTO-ARB" in a standard collet. "AUTO-ARB" is a precision tool, expanding accurately, and maintaining perfect concentricity with the collet. No other tools are necessary—chucking and unchucking can be done without stopping the machine—thus greatly increasing production. It works equally well in "blind" holes, and requires a minimum of holding surface—eliminating the need for special arbors on difficult jobs. It will work with any standard collet, and can also be used to good advantage on drill presses or milling machines with collet devices.

Auto-Arb is available in range of standard sizes, from ⅜" to 1½", at 1/64" intervals. Only 5 collet sizes are required to accommodate this range. Larger sizes available on special order.

Auto-Arb has been proved by production tests—more than tripling production and eliminating downtime of machines. No failures have been reported from the hundreds already in actual service.

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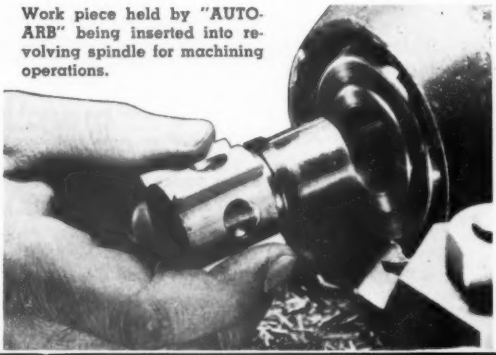
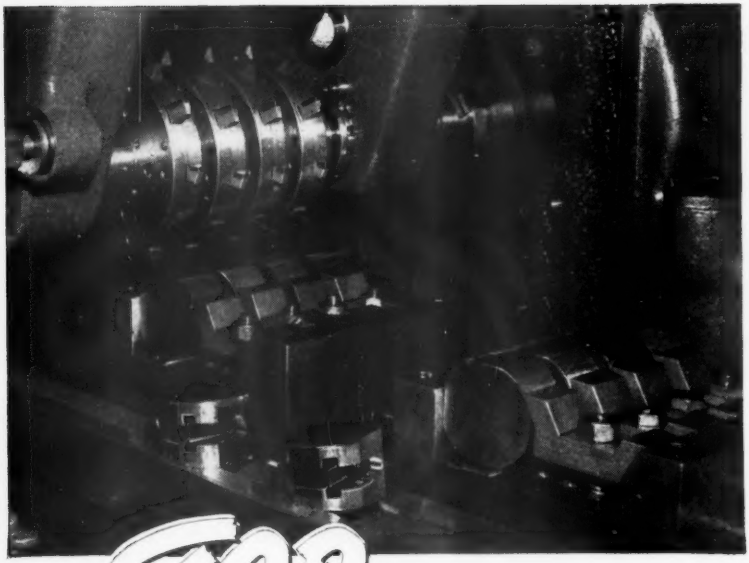


Work piece held by "AUTO-ARB" being inserted into revolving spindle for machining operations.

THE ASCO CORPORATION

17704 Waterloo Road, Cleveland 19, Ohio



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machining stainless steel with FIRTHITE

This unusual operation is being performed by a leading valve manufacturing plant, machining $2\frac{3}{4}$" round 18-8 stainless steel. Ten Firthite T-04 tools are staggered in each of four cutting heads on a milling machine to cut slots $\frac{1}{4}$" deep x $1\frac{3}{4}$" long, containing a 60° angle, $\frac{19}{32}$" at the top of the angle.

The remarkably high output (800 pieces per grind) and the excellent results obtained attest again to the advisability of using Firthite sintered carbide tools for most satisfactory cutting performance.

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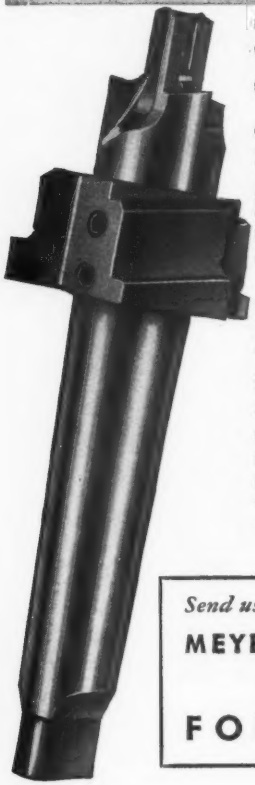

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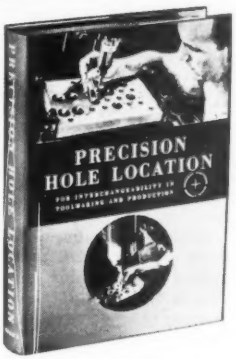
"Precision Hole Location"

A review of an outstandingly valuable book by J. Robert Moore. It is written for toolmakers, by toolmakers, and published by The Moore Special Tool Company of Bridgeport, Connecticut.



The author's preface to his book, "Precision Hole Location," surveys the progress in toolmaking that has made possible today's even more exacting demands in toolmaking techniques and craftsmanship for tomorrow's products.

PREFACE: If Eli Whitney *could awaken from his eternal sleep, his eyes would open wide, indeed. His once frowned-upon theory of mass-production through interchangeable parts-and-assembly manufacture now provides a standard of living for the United States that is the envy of the world. Special tools so reduce hand labor as to bring many former luxuries within the reach of an ever-widening consumer public.*

During the 150 years which have elapsed since Whitney's day, every conceivable product has been mass-produced through interchangeable parts-and-assembly methods —except the tools themselves *which made this possible.*

The generations of toolmakers who followed Whitney have constantly advanced the science of achieving volume production of metal, plastic and wood products, but only now have they reached the point where they can apply the same principles to their own work. The ability to mass produce special tools, dies, fixtures, gages and molds under stringent accuracy requirements is the most significant industrial advance since man grasped the ability to mass-produce end products. What this will mean during the next 150 years defies the imagination.

The single purpose of this book is to show in full detail how one highly important phase of the toolmaking job—accurate hole location through engineered methods—promotes interchangeability at the very source of all mass-production, namely the tool.

J. Robert Moore

★

"Precision Hole Location", by J. Robert Moore, presents the most advanced know-how concerning those toolmaking ways and means of laying-out, boring, grinding and correcting holes to the closest of tolerances that it has ever been this reviewer's pleasure to "discover" between the two covers of a book.

The book's 448 pages are devoted to conveying detailed, working explanations of, and instructions for, attaining to the highest degree, full interchangeability of manufacture, both in toolmaking and in production.

The authoritativeness of the book is derived from the author's expericence

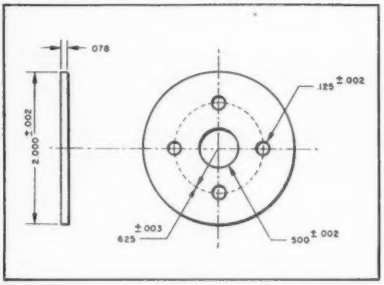


Fig. 7 — Piece part to be made in die shown in Figs. 5 and 6. At this point, it is assumed that the material is thick and that tolerances are broad.

and source material. Long associated with his brother, Richard F. Moore, president, The Moore Special Tool Company, past president and currently a director of the National Tool & Die Manufacturers' Association, J. Robert Moore is a graduate engineer and toolmaker in his own right. His specialization has included precision tool and die work, the evolution of scientific methods controlling the grinding of precision lead screws, and the engineering development of Moore Jig Borers and Grinders.

The inspiring aspect of the work springs from the nature of the job histories that profusely illustrate the text, and the calibre of toolmaking craftsmanship that is set up throughout the book in the light of nothing but the best being acceptable.

Mr. Moore's book is rich with the history of toolmaking and deals with the constantly narrowing of manufacturing tolerances that the toolmaker has had to meet since the early-day "thousandths" of gunsmiths and watch and clock makers, through the "tenths" of World War I, and up to the present-day standards of easily-spoken "millionths". The book details by word and picture all of the toolmaker's methods as they have evolved to meet the challenge of higher and higher precision. He gives factual and generous credit to the other important leaders in his chosen field, i.e., the Pratt & Whitney Company of Hartford, and the Swiss (SIP) of Geneva, Switzerland.

Mr. Moore's clever and refreshing treatment of his subject involves a "plot" that is carried into each of the several chapters dealing successively with more advanced and higher precision methods of hole locating, boring, grinding, inspecting and correcting, i.e., one typical piercing and blanking die that produces the piece part shown in his Figure 7, reproduced herewith. This die design as first detailed is for producing the piece from relatively thick stock and to comparatively broad tolerances. After demonstrating all the ways and means of hole locating applicable to these specifications, the assumption is made that the piece is to be of much thinner stock, calling for smaller die clearances, and with a tightening of all dimensional tolerances to one-fourth and less. This calls for correspondingly higher precision in the die work.

All of the methods of layout are detailed by beautiful drawings and the finest imaginable, close-up photographs of toolmaking procedures. The layout examples start with the combination square and scriber and progress through the more accurate results attainable with the surface gage to the planer gage, vernier height gage and scribers built up on gage blocks.

This reviewer is most impressed by the way Mr. Moore has treated these "pre-

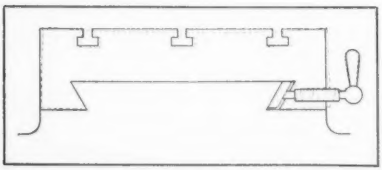


Fig. 94 — Clamping against gibs, although conventional practice in many machines, is inadequate for jig borers. Table movement resulting from this practice, due to spring in all parts, can amount to as much as .001".

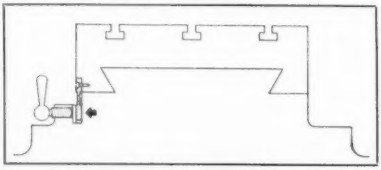


Fig. 95 — Special clamp bar, attached to table of Moore Jig Borer, prevents movement of table from clamping. Bar is rigid endwise, but sufficiently flexible that crosswise pressure for clamping will not influence table position.

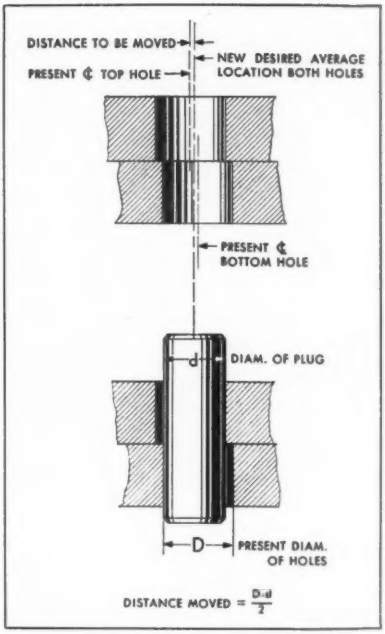


Fig. 278 — Formula for averaging location of two mating dowel holes.

Jig Borer" methods of laying out or locating. He does not speak disparagingly of them, but so thoroughly explains and illustrates the principles, capabilities and shortcomings of each, that these basic techniques can be mastered as they have to be, by the apprentice; and where a job has to be done in a shop limited to these tools, the very best work that can be accomplished with these tools will result from a detailed study of the text and illustrations. The errors and variables are so thoroughly explained that they can be reduced to a minimum in each case.

The same detailed and meticulous treatment is accorded the locating of the die-block on the lathe faceplate by both wiggler-indicating and toolmaker's buttons.

In Figure 25, the author diagrams sixteen steps in drilling, counterboring and finish reaming a .375" hole from a scribed line start. The multiplicity of special tools required and their grinds are shown, and, as he states, once the toolmaker makes such a set, they may be used many times.

As the tolerances of Mr. Moore's job specification are narrowed, he treats extensively the master plate method as developed in the watchmaking industry, and faceplate grinding.

The chapter entitled "What Delayed the Development of the Jig Borer?" is principally historical and can be considered as most essential to the fullest appreciation of the toolmaker's craft.

In the pages devoted to the development of the Moore Jig Borer, there is a wealth of precision know-how for the machinery and machine tool designer and builder. Mr. Moore shows why the design features and construction methods employed have been finally chosen through processes of elimination. Temperature control for the precision lead screw grinding process is fully disclosed, as are lead screw thread inspection and elimination of errors in the fit of screw and nut. The design and construction of the precision components: column, head, quill, bearings, table and ways, and the special purpose gaging equipment developed for each manufacturing step, are frankly portrayed by word, drawing and photograph. All told, it is the kind of information that many manufacturers would consider "top secret"; the drawing, Figure 95, of his method of stress-free table clamping, alone, is worth the price of admission to the gage maker,

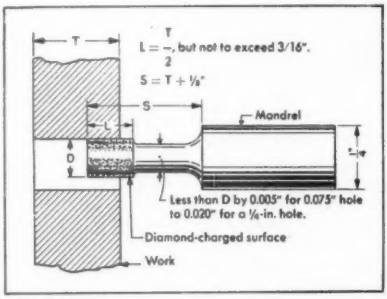


Fig. 239 — Experience with diamond-charged mandrels indicates that these proportions will give satisfactory results

measuring tool and precision instrument designer.

The author's chapters on jig boring and grinding practices follow through with the ultimate refinements in the production of the same piercing and blanking die to the alternate finer tolerance version of the job set up in the first chapter. Additionally, many other more intricate case histories are described, and are accompanied by the detailed jig boring and grinding instructions and precautionary measures applicable to each job.

The thoroughness with which Mr. Moore develops his subject may be gathered from the following quotations from the pages devoted to hole grinding with diamond-charged mandrels: "We do not advocate the grinding of holes of a length or depth of more than six times their diameter. The stiffness of the mandrel will be so much reduced that great difficulty will be experienced in correcting the hole; the mandrel will bend and follow the existing surface, instead of correcting it.

"We have no means of ascertaining specific unit pressures required to accomplish efficient grinding, either with diamond mandrels or abrasive wheels. We find experimentally, however, that when the six-to-one ratio is exceeded, rigidity of the mandrels and consequent efficiency of grinding decrease at an enormous rate.

"The stiffness of the mandrel may be improved by keeping its diameter large in proportion to the hole, but this does not ensure grinding efficiency. The cutting part of the mandrel must always be larger than the clearance portion. As the cutting part approaches the diameter of the hole the arc of contact also increases, resulting in lower unit pressures and consequent loss of grinding efficiency.

"The best results are obtained, both as to rate of stock removal and life of the charged surface, if a constant pressure is maintained between the mandrel and the work. Experience has shown that this amounts to about .0004" to .0005" lead of the feed over the cut until the hole nears size. This can be judged by the apparent rate at which the mandrel cuts, and generally an increase in feed of two or three "tenths" per stroke will maintain this ratio. Never let the mandrel run out at both ends of the hole; work the tight end of the hole by further run-out." These quotations typify the seasoned, down-to-earth, shop know-how that characterizes the book.

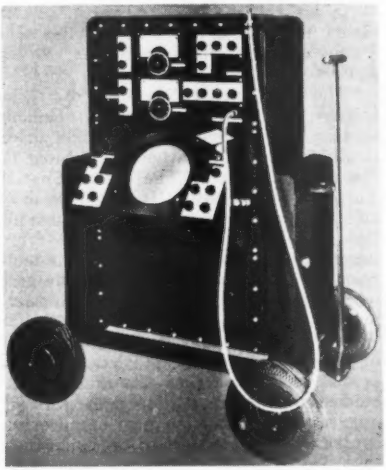
Mr. Moore's seventh chapter introduces, fully explains, and thoroughly establishes the economies of, the new science and practice of interchangeability in toolmaking; in dollars, man-hours, and toolshop customer satisfaction. By text, photographs and drawings, examples of the highest attainments in the art of precision tool and die making appear as a climax built up by the preceding six chapters. Additionally, several pages cover applications of the jig borer to hole inspection, establishing the truth of starting points, determination and interpretation of errors, and a mathematical demonstration of the parallel re-orientation of the workpiece to cancel out errors. The following quotation typifies the author's material used in treating interchangeability in toolmaking: "Under conventional toolmaking practices, wherein the holes are transferred from the die block after hardening and all parts thereafter are made 'to fit' instead of to figures, the die block must be made first, and hardened, before any of the other parts can be made. The stripper and punch plate must wait until the die is hardened, since there is no way to predict the condition or positions of any of the holes in it.

"Use of the Jig Borer-Jig Grinder partnership permits a degree of specialization not possible by transfer methods. Since all parts are made *strictly to dimensions*, the die, stripper, and punch plate may be made concurrently. Development of more accurate habits also permits the making of small punches and bushings by other workers at the same time. In this manner the delivery of new dies to the pressroom is speeded up enormously.

"As an example, the ten-station progressive die, Figure 211, if made under conventional practices, would represent about 2,000 man-hours of labor. Since the parts would have to be made in progressive steps, only one or two men could work on it at a time. Delivery, would require about six months.

Testing Steel for Internal Defects

The Supersonic Reflectoscope, developed by Sperry Products, Inc., is used extensively in steel industries for rapid and non-destructive testing of materials for internal defects and also by heavy equipment users to determine the presence of incipient fatigue failures.



A quartz crystal searching unit is applied to the surface of the material, which has been covered with a light film of oil to improve sound transmission. As it is moved over the surface, the Reflectoscope sends supersonic vibrations through the material and measures the length of time it takes these vibrations to be reflected back from the opposite side or from any defects in the path of the vibration. The pattern on the oscilloscope screen gives a visual indication of the location of any defects. Interpretation of this can be made by an operator after two weeks' training. Sperry Products, Inc., Dept. DJ, 15th & Willow Ave., Hoboken, N. J., will send full particulars on this instrument. INFORM-A-GRAM Key No. G85-T.

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"Interchangeable manufacture permits all the parts to be made concurrently. The Jig Bored die sections, after hardening, are assembled completely on their own dowels in the die shoe. All holes are then Jig Ground. The stripper, hardened stripper inserts, and punch pads are Jig Bored and Jig Ground during the time the die blocks are being fabricated. Six or eight men work on the various parts at once. Man-hours are cut to 1,000 and the die is delivered in six weeks! Moreover, due to its high accuracy, its life is two to ten times that of an unground die."

In concluding his text, Mr. Moore says: "Better and cheaper piece parts make for better and cheaper consumer items. The corollary also holds that better and cheaper tool parts make for better and cheaper tools.

"The Industrial Revolution is too often considered as having happened in the remote past and over with. On the contrary, it is as continuous as motion, and will be a part of our lives until the far-off day of Utopia.

"The producer who doesn't accept that principle in his tool room as well as in his manufacturing processes cannot hope to survive in the expanding era of interchangeable manufacture."

The final section of the book includes 184 pages of Woodworth Tables which greatly simplify calculating rectangular co-ordinates for locating hole centers on a circular layout. There is one table (and diagram) for each circular pattern of holes, 3 to 100 inclusive, and, for example, finding the rectangular co-ordinates for locating each one of 43 equi-spaced holes on a true circle is reduced to multiplying the circle diameter by the two Woodworth factors given for each location. These factors are given to the sixth decimal, and the angular spacing of the holes, for working in polar co-ordinates, is given in degrees, minutes, and fractions of seconds.

In speaking of the tedious and time-consuming operations necessary to make all the individual arithmetical and trigonometric calculations for such dimensioning, Mr. Moore explains: "W. J. Woodworth, of Mineola, Long Island, N. Y., a toolmaker, tool designer and tool supervisor of 40 years' experience, recognized the difficulties in these calculations. With his son, J. D. Woodworth, he set about developing tables to enable Jig Borer operators to obtain the correct figures with the least effort.

"The cost-saving features of these tables have been thoroughly demonstrated over a period of two years prior to publication of this book. Richard F. Moore, president of The Moore Special Tool Company, states, 'It would be difficult to evaluate in dollars the substantial savings which have resulted from use of the Woodworth Tables in our toolroom. To say that they save their cost on a single job is a gross understatement'."

"Precision Hole Location" is the result of painstaking effort and years of research on the part of the author, and evidences the credit due him for his appreciable scientific and engineering contributions to the art of precision tooling. The act of The Moore Special Tool Company in sponsoring and underwriting its publication so as to make it available to the technical reader for the obviously "cost-minus" domestic price of three dollars is deserving of the highest commendation. E.W.P.

AN INVESTMENT, NOT AN EXPENSE!

Editor's Note: The pages we have devoted to Mr. Moore's book indicate our unqualified conviction that it is deserving of the widest possible distribution throughout the metal-working industries. To this we lend our enthusiastic support.

The book is a "must" for machine builders, tooling and production engineers, tool and die makers, for college engineering, technical and trade school students, and for learners and apprentices as well; it should be in the "tool crib" of every technical library.

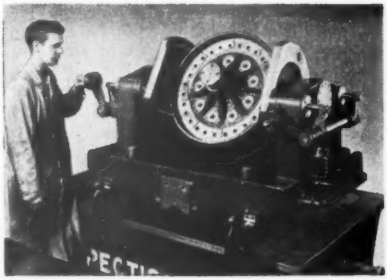
Your order addressed to The Moore Special Tool Company, below, and accompanied by three dollars, should be considered an investment in know-how rather than an expense. E. W. P.

Precision Hole Location
by J. Robert Moore
Published by:
The Moore Special Tool Company
726 Union Ave. • Bridgeport 7, Conn.

Priced at $3.00 in the U. S. A.; foreign, $3.50

McKinney Tooling Facilities

Complete physical plant facilities and a wealth of tool design and production tooling know-how characterize the opertions of the McKinney Tool & Manufacturing Company, 1673 Arabella Road, Cleveland, Ohio. Typical of their intricate tooling projects is this Trunnion Drill Jig for working on aircraft engine parts.



McKinney facilities and services for more than twenty years have been devoted to the designing and building of precision tools, jigs, fixtures, dies, gages and special machinery. They are equally well known in the fields of process engineering, product design, plant layout and routing, as well as for experimental and development engineering.

Large capacity, precision equipment for all machining operations and extensive mechanical and optical measuring and inspection equipment, combined with ideal plant layout and working conditions contribute to the high quality of McKinney craftsmanship. INFORM-A-GRAM Key No. 957-T.

Walker Heads Clinton Tool

Curtis E. Walker, former partner and vice-president of the Turchan Follower Machine Company, now heads the currently expanding Clinton Machine Tool Company, Clinton, Indiana, manufacturers of milling machines, high speed milling heads and hydraulic duplicators, under Walker-Turchan patents.

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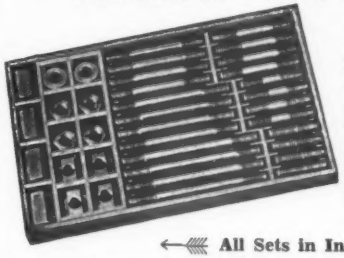
EVERY MACHINE IN YOUR PLANT NEEDS ONE ★ QUICKLY PAYS FOR ITSELF IN TIME SAVINGS



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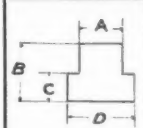
Specially designed T-slot nut will prevent damage to table slots caused by ordinary nuts.



Holes & Thread	A	B	C	D
½"—13 THD.	.555	¾"	11/32"	⅞"
⅝"—11 THD.	.675	1⅛"	15/32"	1⅛"
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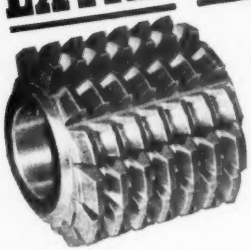
(CONTINUED FROM PAGE 71)

critical 10-inch length must be held to ± 0.003", since even with allowance made for solidification shrinkage in the original die design, the casting would shrink an additional 0.0007" per inch, or .007", after casting due to phase adjustment shrinkage. This suggests redimensioning the machined die cavity from our previously calculated 10.076 to 10.083.

Summary

A number of factors influencing the extent of shrinkage that will take place in die castings produced in steel dies under pressure and under given conditions have been discussed. The effects of these variable factors upon the amount of shrinkage that would normally take place under theoretical or ideal conditions have also been pointed out. It would appear that while a general, all-purpose, practical shrinkage allowance figure will prove satisfactory in designing dies for most die castings, further consideration must be given to certain very simple or extremely complicated castings to arrive at a more exact shrinkage allowance.

EXTRA TOOL LIFE ..... Free



"Another company copied one of your hobs so exactly that we couldn't find the slightest difference under a comparator or as to analysis and hardness. But, on the job, not one of them did better than one-half the production of the Michigan hob!" (From a user's report).

We are not surprised. They did not duplicate the freedom from carbide segregation in Michigan gear cutting tool steels. This freedom means:

1. **Stronger body and teeth—no weak spots**
2. **Better sharpening—less stock removal—more grinds per tool**
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4. **More pieces per grind—cutting edges hold up longer.**

Are you on the mailing list for "GEAR HIGHLIGHTS"? Published regularly as a service to gear users and producers.

MICHIGAN TOOL COMPANY
7171 E. McNICHOLS ROAD • DETROIT 12, U. S. A.

(CONTINUED FROM PAGE 92)

sub-assembly for a large automobile manufacturer. The author strongly suspects that the future of this company is directly bound up with the selection of a new vice-president in charge of operations.

Summary

Because conditions vary so greatly from plant to plant, there is little possibility that any usable rules can be stated for reporting quality control results to management. The following, which are little better than guesses, may have some guidance value:

a) Present summaries, not details.
b) Make it simple, but be sure to tell the story.
c) Dollar savings are most effective, but dollar figures often breed controversy. Perhaps a man-hour report will serve better than a dollar report.
d) Modesty is essential, over-modesty may be fatal.

Bunell Engineering Services

An engineering service, starting at the customer's plant with an analytical review and check-up of machine equipment, processes and facilities is featured by the Bunell Machine and Tool Company, 1601 East 23rd St., Cleveland 14, Ohio. M. O. Shepherd, works manager, accounts for the demand for their highly specialized services in finding that development of postwar tooling and equipment is proceeding faster than normal, even where new consumer product development is retarded by economic factors. The ultimate objective of the Bunell services is the quick marketing of products.

In their field of building special machines and tooling for postwar production and competition, Bunell Engineers emphasize the increasing importance of special purpose machinery geared to the human factor as well as to profits. Their case histories show that lessening the element of fatigue in mechanical operations gives an almost parallel increase in production and profit, other factors being equal. With special equipment designed for a multiplicity of operations, the operator tends to become a highly skilled set-up man.

In one instance, the manufacture of an aluminum ring of 16" diameter incorporated milled, spiral locking slots, drilled peripheral holes and machining on face and three inside diameters. Initially, it was a turret lathe and drill press job. Re-engineered and re-tooled by Bunell for an increased production schedule, three new machines were developed: a special boring machine, a new drilling setup, and a special milling machine for the spiral lock slots. Production was increased over 400%, the three special machines resulting in 16.6 pieces per man-hour as against four per man-hour on the original two.

Bunell engineering service is based on technical know-how that permits analysis of machining possibilities with subsequent simplification. It provides on-the-job checks that permit more accurate estimates on new equipment required, potential savings, and the amortization time required.

For complete details and information regarding this engineering service, contact M. O. Shepherd at Bunell.

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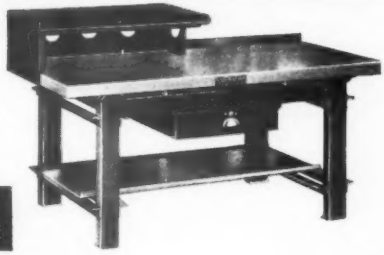

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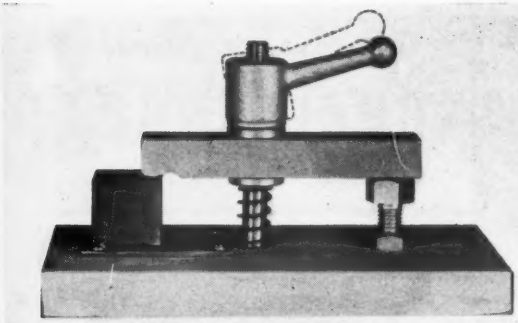

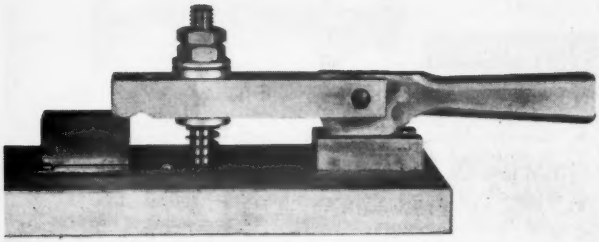

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Suitable for light or heavy duty—available with solid or channel toggle bar adaptable for variety of fixed or adjustable pressure spindles.

FOR HEAVY WORK—*use Toggle-Action C-Clamps*

The quick-fastening and quick-releasing feature of these C-Clamps is particularly advantageous when you work with heavy parts.

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Both toggle bar and handle are horizontal, allowing free movement of operating tools above work, as in drilling, tapping, etc.

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A NEW LOCKING HAND WRENCH, with the gripping strength of approximately one-ton pressure, has a double lever or toggle action permitting it to be used as a combination straight, end or pipe wrench, vise, toggle press, clamp or pliers. Parts up to any size, which will fit the maximum jaw opening of 1¼ inches, can be held by the wrench for tooling, drilling, grinding or machining, without slipping or changing position. Made of alloy steel and all cadmium plated, the wrench is 10 inches long and has a jaw opening of 1¼ inches. For full details write to A. C. E., INC., Transportation Bldg., Dept. 23, Detroit 26, Mich., or use INFORM-A-GRAM Key No. K23-T.

PRECISION INDUSTRIAL TOOLS now offered by Sapphire Products include a wide variety of gages constructed of sapphire. Those illustrated are: hand burnishing tool, sapphire tipt-type cylindrical plug gage, cylindrical plug gage with solid sapphire members, cylindrical plug gage with sapphire inserts, cylindrical plug gage with solid sapphire members, flat plug gage, needle valve gage, ring gages, burnish-polishing tool, sapphire-tipt dial indicator contact points, and standard contact point. For complete details write SAPPHIRE PRODUCTS DIVISION OF THE ELGIN NATIONAL WATCH CO., Dept. 89, 932 Benton St., Aurora, Ill., or use INFORM-A-GRAM Key No. C89-T.

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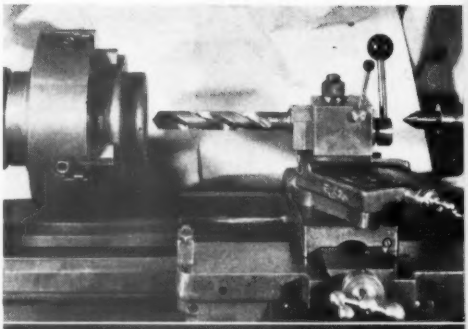
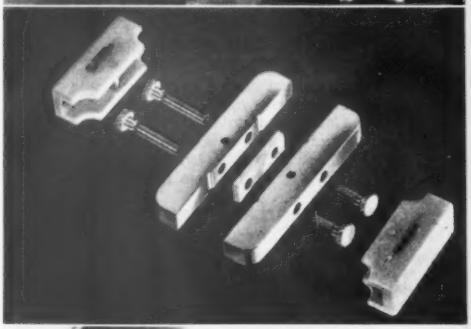
ACCURATE AND ADAPTABLE TO FIT THE COMPOUND OF ANY ENGINE LATHE the Fry Multi-Duty Tool Holder is made in two sizes for large and small machines. Work of every conceivable type can be performed, saving up to 40 percent on lathe time. Drilling, reaming, tapping, boring, turning, facing, recessing, forming, threading, knurling, and cutting off can be done in one chucking without the use of the tailstock. A large solid steel base, with hardened and ground working and locating parts, assures long life and accurate performance. Complete data is available upon request from the AIRO PRODUCTS CO., Dept. 24, 2709 W. 54 St., Los Angeles 43, Calif., or use INFORM-A-GRAM Key No. K24-T.

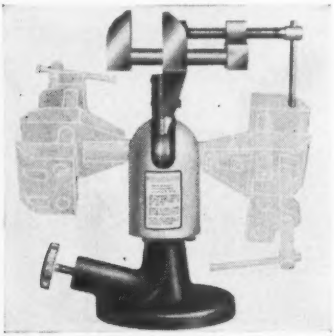


CONSISTING OF A SPECIAL GAGE BLOCK wrung between a pair of chromium-plated special alloy steel jaws and locked into position by brass thumb fasteners, the new Ellstrom "Mastersnap" snap gage is offered by the Dearborn Gage Co. Green thermoplastic insulator for "GO" and red for "NO GO" combinations are fitted over the jaws and held in place by means of plastic pins. By this arrangement, the special gage blocks are not subjected to wear and may be used indefinitely without loss of original accuracy. Complete details of these accurate, nonwearing, interchangeable assemblies are available upon request from DEARBORN GAGE CO., Dept. 1-39, 22038 Beech St., Dearborn, Mich., or use INFORM-A-GRAM Key No. 139-T.



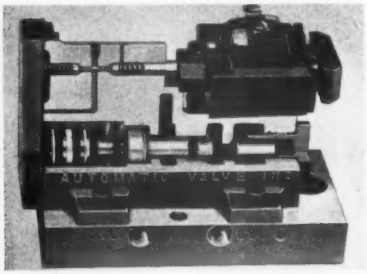
AN ANGLE-TRUE ATTACHMENT, for use on its Waltham Cutter Sharpener, has been developed by Edward Blake Co. The face of the dish wheel used on this machine is dressed by the standard-equipment diamond. The new attachment provides a second diamond for dressing the back and the periphery of the wheel to any desired combination of angles. Gear and thread milling cutters, circular form tools and multiple cutters from the smallest sizes up to 3½ inches in diameter can be sharpened. It can be used for either radial or rake grinding and operates either with index plates or with a pawl device. For further information and literature write THE EDWARD BLAKE CO., Dept. 79, 634 Commonwealth Ave., Newton Centre, Mass., or use INFORM-A-GRAM Key No. 79-T.

HOLDING AND POSITIONING WORKPIECES in any vertical or horizontal position is the function of the Powerarm Universal Positioner. It is adaptable to all kinds of benchwork for quicker and easier production, assembly, service and maintenance. The Powerarm Positioner



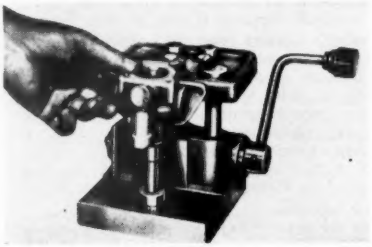
holds light or heavy work and permits turning 360° at any angle on horizontal or axial planes and 180° on vertical planes. A line of universal attachments available with the Powerarm permit mounting many types of work. Complete details are available on request from the GARFIELD ENGINEERING CORP., Dept. 62, Troost Ave. at Bannister Rd., Kansas City 5, Mo., or use INFORM-A-GRAM Key No. H62-T.

POSITIVE AND HIGH SPEED CONTROL OF AIR CYLINDERS, actuating machine tool operations, is the function of the new specially designed 4-way, 4-port solenoid operated airvalve produced by Automatic Valve, Inc. This Model SV-4 is so small, compact and light in



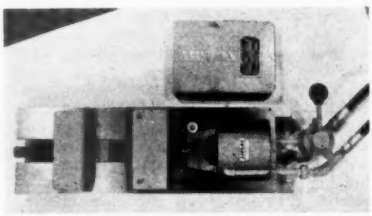
weight, that it can be mounted close to air cylinders, thereby eliminating excessive piping and waste air. These valves are of the pressure sealed poppet, shuttle type, stemless, with short solenoid plunger travel. For complete details write AUTOMATIC VALVE, INC., Dept. 29, 37415 Grand River Ave., Farmington, Mich., or use INFORM-A-GRAM Key No. K29-T.

DESIGNED TO HOLD WORKPIECES TO BE DRILLED, chamfered, tapped, or counterbored, a new device has been marketed by the Lift-Swing Fixture Corp. The interchangeable top plate of the Lift-Swing Fixture swings 180 degrees, permitting the work to be placed, swings back to proper work position and then



is locked into place with a simple crank type handle. Write for literature to LIFT-SWING FIXTURE CORP., Dept. 84, 237 South Avenue, Garwood, N. J., or use INFORM-A-GRAM Key No. J84-T.

DESIGNED TO OPERATE HYDRAULICALLY on six hundred pounds of oil line pressure the new Airlox Senior Vise Model will deliver a ten thousand pound squeeze at the jaw. A complete line of Airlox vises, adaptable as



power jig or fixture, includes styles for practically every requirement. Literature is available upon request from PRODUCTION DEVICES, INC., Dept. 4-32, Whitehall, New York, or use INFORM-A-GRAM Key No. 432-T.

OVERCOMING THE COSTLY WASTE NECESSITATED BY REPLACEMENT of an entire carbide-edged work rest blade when a few chips are the only damage, Scully-Jones & Company have developed a segmented

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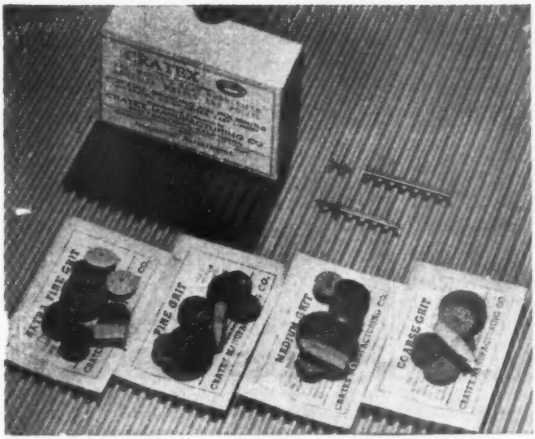

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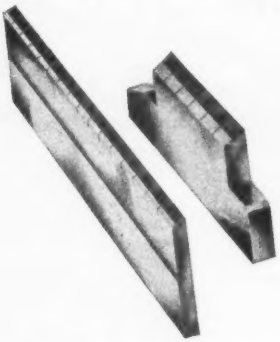
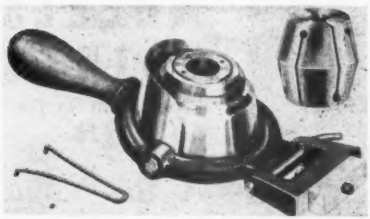
carbide-tipped work rest blade which requires replacement only of imperfect sections, at minimum cost. This special design also makes it possible to use a harder, longer-wearing grade of carbide. Additional details will be sent upon request from SCULLY-JONES & CO.,



Dept. 92, 1901 South Rockwell St., Chicago, Ill., or use INFORM-A-GRAM Key No. C92-T.

ADAPTABLE TO ANY STANDARD BENCH LATHE the new miracle collet chuck can be used with stock up to one inch permitting the full capacity of the lathe. Installed in a few minutes it can quickly and easily be changed and once set cannot get out of adjustment. Extending only 1½" beyond the

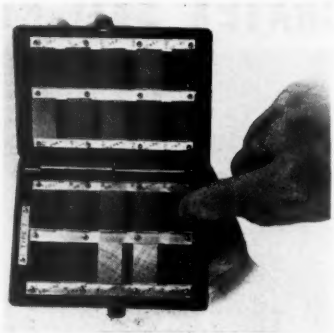


spindle nose of the lathe it assures great accuracy. Additional collets are also available in rounds, squares and hexagons. For further information write MICRO PARTS CO., Dept. TDJ, 322½ East Beach Ave., Inglewood, Calif., or use INFORM-A-GRAM Key No. J40-T.

FLUX WELDING SCALE REMOVAL is effected with ease and speed by use of Optimus Deoxidant No. 3, now being marketed by Optimus Detergents Co. Welding and brazing scale is also eliminated by this compound, which is applicable to a wide variety of metals and alloys, without forming any noticeable amount of smut. Shown herewith are welded and brazed joints as they appear before and after cleaning with Optimus Deoxidant No. 3. Although this is neither a bright dip, nor one intended to replace ordinary pickling acid, it is acidic natured enough for use on most metals as a mild deoxidant which

does not harmfully etch the surfaces. This compound is regularly used on welded steel tubing, brazed hot or cold rolled steel, copper, brass, welded aluminum, cast iron, bronze castings, and most aluminum alloys. Full information will be furnished on request from OPTIMUS DETERGENTS CO., Dept. 99, 165 Church St., Matawan, N. J., or use INFORM-A-GRAM Key No. D99-T.

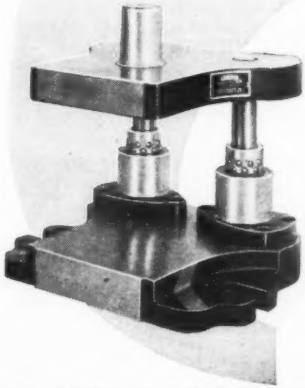
ACCURATELY MACHINED TO THE SURFACE FINISH SPECIFIED for the "Preferred-Number" series the A. S. A. has recently adopted, a handy pocket set of standards, consisting of twenty small blocks of stainless



steel, affording a convenient means of checking surface finishes over a wide scale of roughness, has been developed by University Machine Co. Small differences in surface finish are apparent by the "feel" of the surfaces and, because the blocks are machine cut, the user feels complete confidence in tests made with this set. Write UNIVERSITY MACHINE CO., Division of Baird Associates, Dept. 9-87, Cambridge, Mass., for details or use INFORM-A-GRAM Key No. 987-T.

★ ★ ★ ★ ★ ★

SAVE UP TO 60% OF DIE SETTER'S TIME WITH LEMPCO ANTI-FRICTION DIE SETS



On one die, Atlantic Tool and Die Company saved 40 hours of assembly and set up time, by using Lempco Anti-Friction Die Sets.

Lempco Anti-Friction Die Sets are equipped with ball or roller bearing guide pins. That's why dies can be set up by hand without the use of hammers, mauls, jacks or pry bars. This eliminates production delays caused by accidents to die and punches—saves up to 60% of die setter's time. Lempco Anti-Friction Die Sets positively eliminate all down-time caused by bound, scored or galled guide pins.

Write for fully illustrated booklet, "Facts About Lempco Anti-Friction Precision Die Sets."

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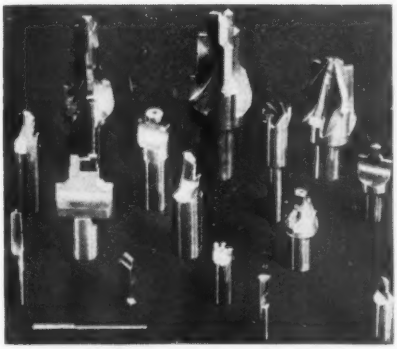

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Our entire organization is keenly interested in "Form-Grinding" and its problems. Facilities include J. & S. "Form-Dressers," J. & S. "Form-Grinders," and all necessary form-grinding equipment. The "know-how" developed by supplying some of the outstanding manufacturers in industry, is available for your quality tool requirements—and at competitive prices. Your requests for quotation are solicited on that basis.

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Manufacturers of "Fluidmotion" Radii and Angle Dressers

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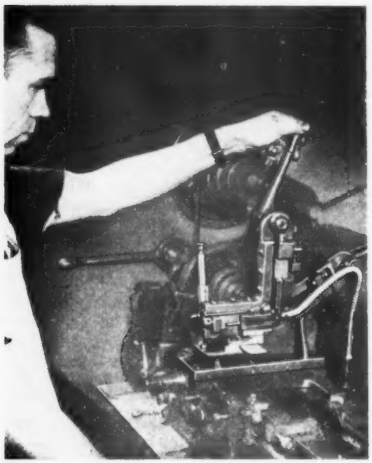
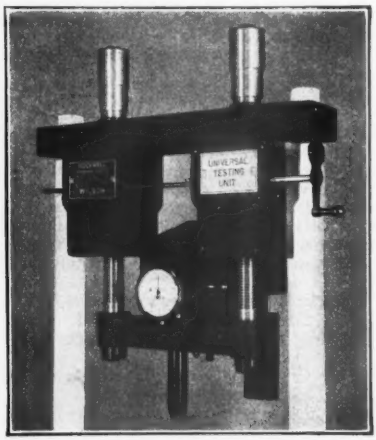
MAKING ANY LATHE OR SIMILAR TOOL INTO A QUANTITY PRODUCTION MACHINE for multi-diameter parts, the new Oxford Swiss Type Converter will produce any part from a needle point to ½" o.d., and from ¼" length



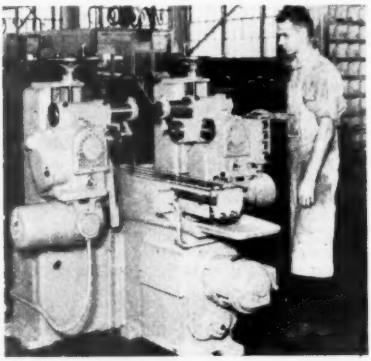
to six feet. Tooled by means of simple cams, this converter can be used with any standard lathe, old or new. Write to OXFORD ENGINEERING, INC., Dept. 17, Oxford, Mich., or use INFORM-A-GRAM Key No. K17-T.

RECOMMENDED FOR TEST'NG HEAVY AND LARGE WORK not readily tested in



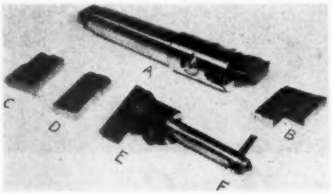
standard size "Rockwell" Hardness, or Superficial Hardness Testers, the Universal Testing Unit can be mounted in whatever design of rigid frame the user finds will best and most conveniently meet his particular testing needs. Further information about this new testing unit can be obtained by writing WILSON MECHANICAL INSTRUMENT CO., INC., Dept. 6-76, 383 Concord Ave., New York, N. Y., or use INFORM-A-GRAM Key No. 676-T.

MILLING TWO SURFACES SIMULTANEOUSLY ON OPPOSITE ENDS of very small workpieces, the new Rigidmill promises to reduce time and machining costs. Its two horizontal opposed spindle heads, through an 11-inch adjustment range, permit cuts on opposite ends



of the part at different heights. Additional material about this duplex milling machine can be requested from the SUNDSTRAND TOOL CO., Dept. 36, Rockford, Ill., or use INFORM-A-GRAM Key No. 36-T.

RECENTLY DESIGNED AND ADDED TO THEIR LINES, the Behr Products Co. announces the following new products: modern and sturdy Boring Bar, Taper Shank Model, with the new



Boring Blade inserted; Standard Facing or Shoulder Boring Blade, always cuts flat and square with the Spindle Axis; new Back Facing or Inverted Boring Blade; a double End

Accurate Tapping for Stronger Fastenings

Tighter, vibration-defying, enduring fastenings result when thread tolerances are held to extremely close limits by accurate tapping.

HY-PRO Ground Thread Taps consistently produce accurate threads. Their extra hardness and durability result in longer life, more work between sharpenings . . . to cut costs and speed production.

PROMPT DELIVERY, Many special as well as standard taps in stock.

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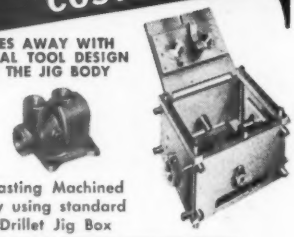
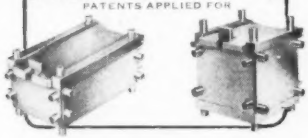
NEW *Drillet*
JIG BOX
CUTS DRILL JIG COSTS 75%

DOES AWAY WITH SPECIAL TOOL DESIGN OF THE JIG BODY



Casting Machined by using standard Drillet Jig Box

BUILT IN STANDARD SIZES AND SHAPES UP TO 6" x 6" x 6"
PATENTS APPLIED FOR



The Drillet Jig Box is a six sided leaf type jig for all phases of drill press operation. Tooling expense can be reduced as much as 75%. All that is necessary is for toolmaker to locate part and insert drill bushings. Eliminates preliminary steps required in building and squaring jig. Side plates, end plates and leaves are replaceable for immediate delivery. Before investing hundreds of dollars in your toolmaker's time —Write for Literature and Prices.

Full Scale Tracing Templates with Orders on Request.

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DRILLET CORPORATION
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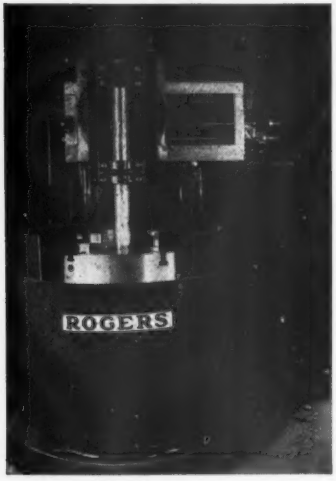
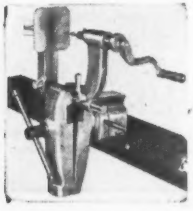
Cutting Blade used for roughing and finishing in one pass over the work; and a new small Hole Adaptor for holes smaller than 2" diameter. Details are given in Catalog 102A available from BEHR PRODUCTS CO., Dept. 14, 13732 Woodward Ave., Detroit 3, Mich., or use INFORM-A-GRAM Key No. K14-T.

EQUIPPED WITH ADJUSTABLE FIVE-POSITION MAIN VERTICAL TURRETS, the new special boring mill, a modification of Rogers' "Perfect 36" Vertical Turret Mills built in

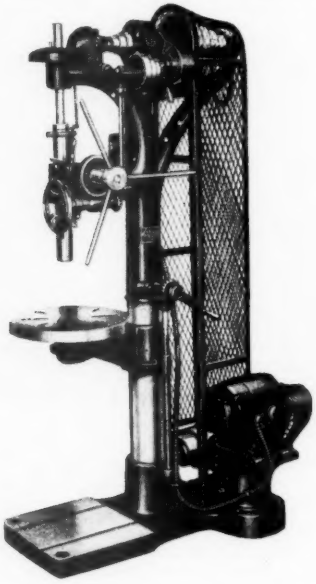


standard and high speed models, has swivel side heads, horizontal four-jaw chucks, oversize spindles, motor driven rapid traverse, and convenient foot controls. Complete information on modified and standard models is available by writing ROGERS MACHINE WORKS, INC., Dept. 4-46, 1807 Elmwood Avenue, Buffalo 7, N. Y., or use INFORM-A-GRAM Key No. 446-T.

PORTABLE VISE AND DRILL COMBINATION TOOL, recently introduced under the name Twin-Tool, consists of two separate tools that can be used in combination or individually. The portable vise swings on a vertical axis turning to any angle; the portable drill has a wide range of applications. In combination a horizontal drill press is obtained, or by turning the vise in the bench plate 90° it becomes a vertical drill press. For complete details, write W. H. HOWLAND, Dept. 16, 2533 East 73 St., Chicago 49, Ill., or use INFORM-A-GRAM Key No. K16-T.



ESPECIALLY DESIGNED FOR DRILLING up to 1¼" in cast iron, or equivalent in other metals, the new 20" Drilling Machine, developed by The Sibley Corporation, offers wide interchangeability. The unit is standard with



motor drive and belt guard or, where it is necessary to operate the machine from a line shaft, with tight and loose pulley drive. Catalogue No. 65 gives complete specifications, available upon request from Mr. Milton Shultz, SIBLEY MACHINE AND FOUNDRY CORP., Dept. 12, 206 E. Tutt St., South Bend 23, Ind., or use INFORM-A-GRAM Key No. K12-T.

FOR PRECISION TAPPING, a new lead screw "Tapmaster" unit can convert in a few minutes a standard 15" drill press into a (class 3) tapping machine. Ideal for short runs of precision tapped threads in tools. Any make of Tapping Head can be used with a single-phase motor. Where two- or three-phase motors are employed a "Switch-O-

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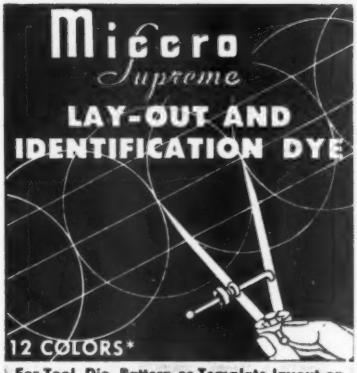

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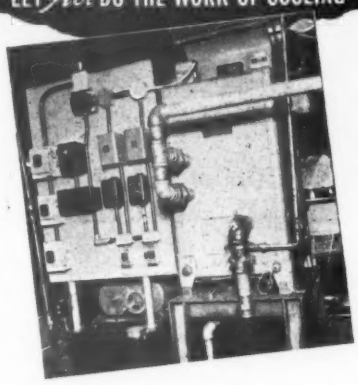

● The NIAGARA AERO HEAT EXCHANGER makes the atmospheric air take up the heat you want to remove from power equipment or industrial process. It is done by the evaporation of a small amount of water, removing 1000 BTU for every pound of water evaporated. With this method it is also easy to control temperatures closely . . . to assure accuracy in process results . . . speeding up production at lower cost.

Well designed and built to last, NIAGARA AERO HEAT EXCHANGERS have made an excellent record for reliability in service and freedom from maintenance trouble and expense.

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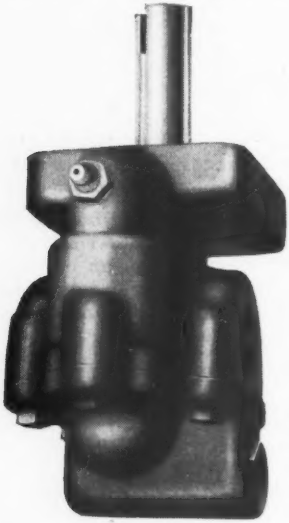
OPERATED BY PULLEY OR DIRECT DRIVE the "New All-Bronze Gear Pump" can be mounted internally or externally in a variety of positions. The "GB" series, as they are



called, can be used for pumping all chemicals, oils, and other liquids of corrosive or non-corrosive nature, which do not affect bronze. Catalog sheets with detailed information are available from GRAY-MILLS CORP., Dept. 5-55, 1948 Ridge Ave., Evanston, Ill., or use INFORM-A-GRAM Key No. 555-T.

MARKING DELICATE OR PRECISION PARTS having a ground or mirror surface that should not be marred or distorted, Jas. H. Matthews & Co. has designed an "Airgrit" Marking Machine. Employing a celluloid or patented

rubber stencil, short blasts of fine grit result in a light, clear-cut non-liquid impression without any burred surface. For further specifications and information write JAS. H. MATTHEWS & CO., Dept. 50, 3943 Forbes St., Pittsburgh, Pa., or use INFORM-A-GRAM Key No. 50-T.

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A steel for blanking, forming, drawing, trimming and shearing tools. PRK-33 has long life in dies and is unsurpassed on production runs. Simple to heat treat with uniform hardness penetration to the center and secondary hardness. Has high tensile strength and resistance to abrasion.

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Save time in setting up milling machine cutters, and wherever accurate spacing must be obtained and *maintained.*

Made of metal. Not only for greater accuracy, but also because they will not be affected by heat or oil. And can be used over and over. Standard sizes from .001" to .125". Specials, cut from bar stock, in any length and ground to decimal.

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Established Over 30 Years
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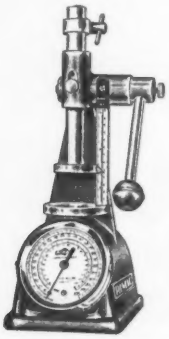
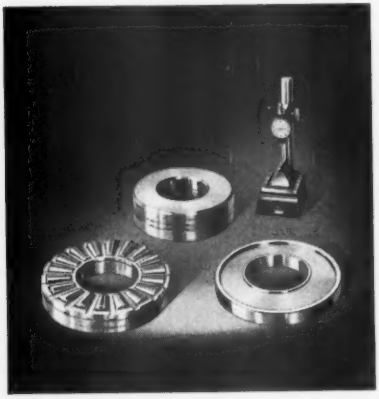
equipped with high-speed steel blades having an all-purpose grind for cutting efficiently into materials. Kit No. 790 contains two adjustable hole cutters for all diameters 5/8" to 2½". For further information write to BRUNO TOOLS, Dept. 19, Beverly Hills, Calif., or use INFORM-A-GRAM Key No. K19-T.

EXTENSIVELY USED IN FACTORY PRODUCTION LINES for testing valve springs, the No. 67 model of Rimac Spring Testers is

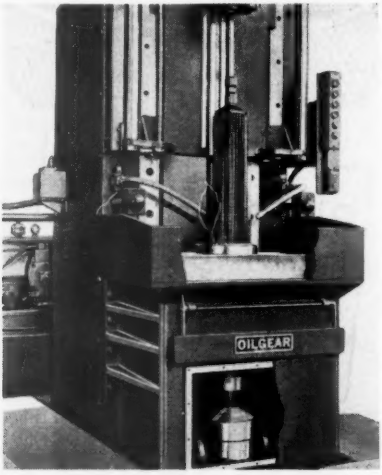


invaluable for testing many other compression springs within its capacity of 250 pounds. A large dial face, four and a half inches in diameter, permits more accurate reading. For full details write RINCK-McILWAINE, INC., Dept. 11, 16 Hudson St., New York, N. Y., or use INFORM-A-GRAM Key No. K11-T.

ADAPTABLE TO HEAVY DUTY EQUIPMENT, conical roller thrust bearings, designed to supplement the straight roller type, are used extensively in oil field swivels, steel mill equipment, paper mill machinery, and other heavy duty equipment. Higher speeds, which are constantly demanded in many types of equipment, are easily handled by this type of bearing. The design is such that the apex of the cone formed by the rollers meets at the true center of the bearing, which permits the rollers to align themselves between the tapered faces and the outside rib of the raceways. A one-piece Kaydon bronze cage acts as a separator. Standard sizes are available, from 9⅞" OD to 19½" OD and load capacity up to 440,000 lbs. Complete details may be requested from THE KAYDON ENGINEERING CORP., Dept. 50, Muskegon, Mich., or use INFORM-A-GRAM Key No. G50-T.



THIRTY-THREE INTERNAL INVOLUTE SPLINES ARE FINISH BROACHED, in 8½" diameter steel clutch driving ring plates, in a single pass on the Oilgear Type XP-30 x 54" Stroke Vertical Pull-Down Broaching Machine. Operator loads and unloads clutch plates, the 370 pound tool is handled automatically. Approximately .530" stock is removed on the inside diameter at a production rate of 120 plates per hour. Cutting and return speeds are variable; respectively 30



and 80 feet per minute. Write THE OILGEAR COMPANY, Dept. 44, 1301-1417 W. Bruce St., Milwaukee 4, Wis., or use INFORM-A-GRAM Key No. E44-T.

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Concave, convex or flat surfaces on machinery, dies, patterns, tools, castings, steel forgings, pottery, metal sheets, plastics, bakelite, rubber and stone can be finished faster, easier, cheaper with this high speed Mall Countershaft Grinder. In addition, it gets to hard-to-reach places on machines or other industrial equipment. A big time, labor and material saver for bench work or when rolled to the product. Full ball bearing mounted spindles make for vibration-free, cool operation.

Mall High Speed Countershaft GRINDERS are available in ¾ H.P.—speed range from 1650 to 7400 r.p.m.—also Mall Rotary Hand Cut and Mill Cut Files in coarse, medium or fine grades, in a wide variety of shapes.

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DESIGNED FOR USE ON REVERSIBLE MACHINES, the Procunier Style "C" Friction Tap Holder allows the operator to control the amount of power needed to drive the tap within the capacity of the tap holder. An internal safety friction device instantly slips if the tap sticks or strikes bottom. The many uses and applications of this tap holder are described in a new two-color brochure now available by writing to PROCUNIER SAFETY CHUCK CO., Dept. 6-23, 18 S. Clinton St., Chicago 6, Ill., or use INFORM-A-GRAM Key No. 623-T.

MULTIPLE DRILLING AND TAPPING OPERATIONS ON SMALL PARTS are depicted in great variety in Bulletin No. 31 just issued by the Ettco Tool Company. The construction and functional details of Ettco-Emrick multiple drilling and tapping units are shown and explained so thoroughly as to enable anyone to visualize any and all possible applications of the units. Many case histories of actual production jobs are illustrated and the accompanying text explains the tooling and jig and fixture features in each case. For your copy of this highly informative catalog, write to the ETTCO TOOL CO., INC., 594 Johnson Ave., Brooklyn 6, N. Y., mentioning Tool & Die Journal, or use our postage-free INFORM-A-GRAM Key No. 30-T.

CARBIDE AND CAST DIES in a wide variety of standard shapes and sizes as well as special designs are produced by Penn Carbide and Alloy Casting Co. Powder Metallurgy, precision casting and special casting, and other methods are discussed in data available upon request from PENN CARBIDE & ALLOY CASTING CO., Dept. 98, Canonsburg 2, Pa., or use INFORM-A-GRAM Key No. 198-T.

USING ACCURATE STEEL RULE CUTTING DIES, an inexpensive process of die cutting for thin metals such as aluminum, tin, brass, and copper has been perfected. It is described in the "Die Cutters Manual". To save you time, cutting dies used in this method are available the same day they are ordered. Request the manual from ACCURATE STEEL RULE DIE MFRS., Dept. 73, 22 W. 21st St., New York 10, N. Y., or use INFORM-A-GRAM Key No. 173-T.

DISCUSSING THE PLACE SPECIALIZED TOOL, MACHINE, AND DIE JOB SHOPS HOLD in the present industrial picture, M. O. Shepherd, Works Manager, The Bunell Machine & Tool Co. has written three booklets dealing with this subject. They are, "The Captive Shop", "Let's Talk It Over", and "Obsolescence In Men, Methods, Machines". Copies of these booklets can be procured by writing THE BUNELL MACHINE & TOOL CO., Dept. 8-86, 1601 East 23rd St., Cleveland 4, Ohio, or use INFORM-A-GRAM Key No. 886-T.

ADJUSTABLE FLUSH PIN GAGES, designed for building into checking fixtures or for use as a hand measuring and inspection tool, are described in detail in a new, 4-page bulletin

available from SCHNACKE, INC., 1016 E. Columbia St., Evansville 7, Indiana. Seven typical applications of this new gage and method, including the checking of plain and threaded hole depths, counterbores, shoulders, and surface plate setups, are shown by drawings that suggest many other applications. For more information as to the toolmaking and inspection economies that can be gained with the Schnacke Adjustable Flush Pin Gage, write to the manufacturer, Dept. 46, or use our postage-free INFORM-A-GRAM Key No. F46-T.

CO-ORDINATING PRODUCT DESIGN WITH TOOL DESIGN, Tooling, Engineering and Manufacturing are functions carried on by the Barth Organization. A new brochure pictorially describes some of their machine installations, completed dies, and progressive stamping operations. A separate cam department specializes in cams for Swiss Type automatics and many other special machines. Copies of this brochure are available on request from the BARTH STAMPING & MACHINE WORKS, Dept. 33, Denison Ave. and West 34th St., Cleveland 9, Ohio, or use INFORM-A-GRAM Key No. G33-T.

HOLDING THE WORK WHILE IT DETERMINES THE ANGLE, the Bemisine Angle Plate consists of a drilled and tapped steel plate mounted pivotally in a right angular base. Angles accurate within one minute of arc are set up in less than a minute, using either a micrometer or gage blocks. Instructive descriptions and illustrations of this tool are in a folder now available from the NICHOLS-MORRIS CORP., Dept. 9-43, 44 Church St., New York 7, N. Y., or use INFORM-A-GRAM Key No. 943-T.

DESIGNING JIGS AND FIXTURES is simplified for the designer when standard accessories are available. A complete line of these is

listed in a new catalog, in the form of loose sheets for three-ring binder insertion, by Jergens Tool Specialty Co. Drawings, which can be used as templets for tracing, illustrate the many items available. These are dimensioned in such a manner that size and part number can be easily chosen. The parts illustrated here are representative of the items manufactured. Copies are obtainable on request from JERGENS TOOL SPECIALTY CO., Dept. 18, 712 E. 163rd St., Cleveland 10, Ohio, or use INFORM-A-GRAM Key No. J18-T.

CHECKING A SURFACE FOR ITS SUITABILITY by comparing it with a surface of known quality, the Comparascope evaluates surfaces by employing the simple optical principle of light striking at an angle. On a perfect surface the light is reflected away from the observer's eye and the surface appears black, but as the finish coarsens, the surface interruptions cause it to be etched with white lines. Automatically focusing and removing any possible visual defects, this instrument is explained in full and illustrated in the booklet now available from THE COMPAR-INSTRUMENT CO., Dept. 1, Detroit 3, Mich., or use INFORM-A-GRAM Key No. K1-T.

CONDUCTING A VISIT TO THE DEPARTMENTS, MACHINES, AND MEN, each with special skills at work for the Star Machine and Tool Company, the new three-color, 44-page booklet recently issued by this company also includes a complete equipment list. Full-page photographs give close-up operational views of the dies, jigs, fixtures, gages, special machinery, jig boring and planer equipment, and production parts which serve Star to turn out according to contract specifications tools, jigs, fixtures and other production equipment. This interesting literature will be sent upon request from THE STAR MACHINE AND TOOL COMPANY, Dept. 6, 9320 Woodland Ave., Cleveland 4, Ohio, or use INFORM-A-GRAM Key No. K6-T.

A PRECISION-BUILT, new Porst positive gripping collet chuck has a lever-action principle which maintains precision operation on all types of metals and plastics. Built for a job requiring durability, capacity and speed of operation, it threads onto the lathe spindle to provide minimum overhang. Dimensions and specifications are listed in a bulletin available upon request from PORST BROS., Dept. 61, 259 W. California Ave., Chicago 12, Ill., or use INFORM-A-GRAM Key No. F61-T.

SLOTTING UP TO 5" IN LENGTH AND 5/8" IN WIDTH, the Glenny Adjustable Expansion Push Broach can cut keyways in 1/10 the time needed with the Shaper Method. The cutter blades will allow several regrinds before replacements become necessary. An illustrated brochure, with engineering data, standard specifications, and price lists will be

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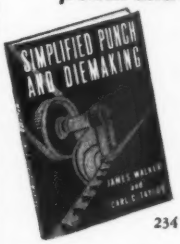

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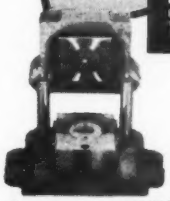

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sent upon request from EAST SHORE MACHINE PRODUCTS CO., Dept. 54, 835 E. 140th St., Cleveland 10, Ohio, or use INFORM-A-GRAM Key No. D54-T.

BUILT IN 2 SIZES, TOOL ROOM AND PRODUCTION MODELS, Diamonds' Model 30 has rigidity, accurate precision, and the capacity of a larger milling machine. Model 20 is an economy model, when a bench mill is too small and a large mill too expensive. Construction hi-lights appertaining to all Diamond Punch Press models, illustrations and data of attachments and accessories are listed in a bulletin recently issued and now available from DIAMOND MACHINE TOOL CO., Dept. 2-68, 3429 E. Olympic Blvd., Los Angeles 23, Calif., or use INFORM-A-GRAM Key No. 268-T.

RAPIDLY DUPLICATING INTRICATE PARTS IN COPPER, bronze, stainless steels, aluminum, etc., the redesigned Di-Acro Brake often will replace die operations. For unusual duplicating operations these standard forming blades can be quickly removed and replaced with special blades easily prepared on the job from stock materials. A 40-page illustrated catalog will be sent upon request from O'NEIL-IRWIN MFG. CO., Dept. 20, 315 Eighth Ave., Lake City, Minn., or use INFORM-A-GRAM Key No. 20-T.

PERFORATING MATERIALS UP TO AND INCLUDING ¼" THICK MILD STEEL, Whistler's new "SX" series of heavy duty adjustable dies marks another die making achievement. Catalog No. 45A contains diagrams and specifications of die assemblies, punches and bushings, adjustable punch and die units, tee-slot die sets, and press brake die sets. This illustrated 16-page pamphlet is available upon request from S. B. WHISTLER & SONS, INC., Dept. 88, 748-756 Military Rd., Buffalo 17, N. Y., or use INFORM-A-GRAM Key No. 88-T.

QUICK SET DRILL SHARPENER with a quick-set dial eliminates guesswork, keeps drills drilling faster. Precision built, calibrated and tested, the unit is easy to set up and operate, will hold drills 5/32" to 1" in size. The dial insures accuracy in sharpening and measuring angles and clearance on twist drills. A bulletin illustrating setting up instructions is available on request from AMERACO INDUSTRIAL SPECIALTIES, Dept. 26, 1047 E. 76th St., Chicago, Ill., or use INFORM-A-GRAM Key No. K26-T.

A BASEBALL BAT MUST BE FREE FROM KNOTS and High Speed Tools must be free from carbide segregations is the comparison made in a new bulletin issued by Latrobe Electric Steel Co. Photographic samples of standard process and desegatized steels show the difference in grain structure of the samples. Copies of this bulletin are available on request from LATROBE ELECTRIC STEEL CO., Dept. 3-67, Grant Bldg., Latrobe, Pa., or use INFORM-A-GRAM Key No. B67-T.

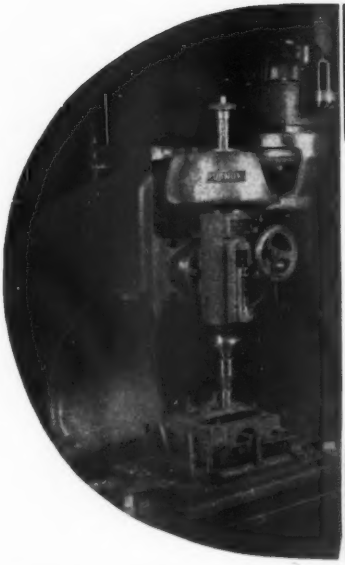
POWER FILING WITH ROTARY FILES is discussed in a new brochure recently issued by Grobet File Co. of America. From their long experience in the manufacture of rotary files, they recommend that Hand Cut Rotary Files should be used for filing hard metals, such as tool steel, carbon tool steel and cast iron, Ground Cut and Milled Cut Rotary Files should be used for filing soft metal such as aluminum, and Hand Cut Rotary Rasps should be used for filing wood. These different types of rotary files with a wide range of shapes and sizes are listed in this brochure. Copies are available on request from GROBET FILE CO. OF AMERICA, Dept. 7-05, 421 Canal St., New York 13, N. Y., or use INFORM-A-GRAM Key No. 705-T.

THE LATEST REFINEMENTS OF THE KEMPSMITH TYPE "G" all-geared milling machines are presented in bulletin No. 102R, illustrated with descriptive details of models No. 1, 2 and 3; plain miller and Universal milling machines which have the swivel table, dividing head, universal chuck and spiral cutting mechanism. Attachments for type "G" millers are also shown in the bulletin, available upon request from KEMPSMITH MACHINE CO., Dept. 47, Milwaukee, Wis., or use INFORM-A-GRAM Key No. C47-T.

FEATURING A HARDENED AND TAPERED INDEXING MECHANISM, Enco Tailstock Turrets are manufactured of Meehanite, high grade close grained semi-steel, with all parts fitted within close tolerances. This turret saves tool changing time as it has six tools mounted instead of one. Three models are discussed and illustrated in literature now available from ENCO MFG. CO., Dept. 30, 4522 W. Fullerton Ave., Chicago 39, Ill., or use INFORM-A-GRAM Key No. B30-T.

LONGER WHEEL LIFE AND BETTER GRINDING. Three models of Kipp Featherweight Air High Speed Grinders are presented in Madison-Kipp Corporation's new catalog AT3005. Model JA takes wheels up to ⅞"; Model TT, small enough for grinding in die cavities, can use wheels up to 1¼"; Model PVT is a power tool which works on the Vane Type principle and is suitable for the heavier tool room and production jobs requiring wheels up to 2½" in diameter. Complete list of wheels, cutters, and time-saving accessories is shown, along with their prices. Copies of catalog AT3005 are available from MADISON-KIPP CORP., Dept. 86, 20 Waubesa St., Madison 4, Wis., or use INFORM-A-GRAM Key No. B86-T.

EASILY AND SAFELY CHANGED IN THREE SECONDS without stopping the power tool, the Rayco Quick Change Chuck can be used to great advantage wherever higher operating speeds are required. One Rayco Chuck and



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its adapters, plus one power drill, can do the work of six. Literature is available from RAYCO MFG. CO., Dept. 89, 3911 S. Prairie Ave., Chicago 15, Ill., or use INFORM-A-GRAM Key No. J89-T.

ABRASIVE DUST, METAL PARTICLES, FINE CHIPS, FLAKES AND OTHER DIRT are thoroughly removed with the Ideal Dust Collector, and warm, clean air is exhausted back into the room. Compact in size, and serving either one or two machines, the machine removes dust with two cyclone cleaners while the filters remove the remaining fine dust. A folder explains how it saves heat and money. Send to IDEAL INDUSTRIES, INC., Dept. 30, 1294 Park Ave., Sycamore, Ill., or use INFORM-A-GRAM Key No. H30.5-T.

SIMPLY DESIGNED AND CONSTRUCTED the Hartford V-Block Fixture can rapidly be set up for holding irregular work, saving valuable time in milling, boring, drilling inspection, and insuring better work. It speeds up the toughest setups proving to be a worth while investment for any machine shop. More information is available on request from the HARTFORD SPECIAL MACHINERY CO., Dept. 5-75, Hartford, Conn., or use INFORM-A-GRAM Key No. 575-T.

CLEANING CONTACT WHEEL BELTS AS IT ROTATES, the patented Presto Contact Wheel is designed of tough, resilient neoprene rubber to give the belt 72 hammer-like cleaning strokes per wheel revolution. This belt and the special Presto Back-Stand Idler, which accommodates any length belt from 84" to 168", are described and illustrated in the looseleaf Bulletin No. 104 available upon request from the MANDERSCHEID CO., Dept. 33, 810 Fulton St., Chicago 7, Ill., or use INFORM-A-GRAM Key No. B33-T.

PERMITTING HIGH SPEED CUTTING in excess of that provided by regular dry cutting machines, the Standard Dry Cutting Johnson Saw has been adapted to the use of a coolant system to give maximum cutting efficiency without impairing the simplicity of operation. Equipped with an automatically controlled centrifugal pump, this coolant feature also may be adapted to existing dry model saws. Full details are available from the JOHNSON MFG. CO., Sales Office, Dept. 6-48, 5000-4 Chrysler Bldg., New York, N. Y., or use INFORM-A-GRAM Key No. 648-T.

READING TO TEN-THOUSANDTHS OF AN INCH becomes as easy as to one thousandth of an inch with the clearly inscribed, accurate vernier of the new Scherr Micrometer. Greater durability, enduring precision, smooth, uniform "feel" are true of all Scherr micrometers as well as G. S. Dial Test Indicators and all tool makers' and machinists' specialties. Features and specifications are listed in a micrometer bulletin available upon request from GEORGE SCHERR CO., INC., Dept. 4-90, 200 Lafayette St., New York 12, N. Y., or use INFORM-A-GRAM Key No. 490-T.

RETAINING ITS HARDNESS AT ELEVATED TEMPERATURES, Rexalloy cutting tool tips of cast, non-ferrous alloy with basic elements of cobalt, chromium, and tungsten will increase metal removal 50% to 500% over H.S.S. tools. Applicable on practically all machining operations, Rexalloy tools should be used with as heavy feed as possible (2 to 4 times the feed used with carbide tools; 2 times the feed of H.S.S. tools). Explanatory Rexalloy Catalog No. 202 with price lists can be requested from GENERAL TOOL & DIE CO., Dept. 36, 555 Prospect St., E. Orange, N. J., or use INFORM-A-GRAM Key No. G36-T.

A SPECIAL STEPCHUCK AND CLOSER COMBINATION, for 6" and 10" Atlas, 92 South Bend, 10" Logan and 12" Clausing lathes, is illustrated in a bulletin issued by the Gilbert Baker Midlam Co. A tapered ring and a threaded closing sleeve give more positive closure than the same action usually employed on a tapered shoulder of the chuck head. The stepchuck and closer will handle work up to 2¼" diameter. Copies will be sent on request from the GILBERT BAKER MIDLAM CO., Dept. 8-41, Dayton, Ohio, or use INFORM-A-GRAM Key No. 841-T.

DEVELOPED TO FILL THE NEED OF INDIVIDUAL MACHINE TOOL POWER with the correct range of speed, Lima Gearshift Drives are engineered to fit all requirements. Also offered is a drive unit covering input torque ratings up to 60 pound-feet for belt drive from separate motor. All Lima Pedestal Grinders, Polishing and Buffing Lathes are equipped with Lima's drip-proof motor, designed for maximum protection against flying chips, filings and dripping liquids. Illustrated 6-page bulletin is available upon request from THE LIMA ELECTRIC MOTOR CO., Dept. 5-71, Lima, Ohio, or use INFORM-A-GRAM Key No. 571-T.

FASTER, SMOOTHER WORK ON STEEL, iron, bronze, brass, aluminum, magnesium, plastics, wood, rubber, glass and other materials, the new Precise 40 tool grinds, mills, deburs, engraves, polishes, finishes, and sharpens. Sold separately, or in complete sets, it has a full 1/5 h.p. motor, weighs 40 oz. and has a speed of 40,000 rpm. Detailed information is available upon request from PRECISE PRODUCTS CO., Dept. 21, 1328-30 Clark St., Racine 4, Wis., or use INFORM-A-GRAM Key No. B21-T.

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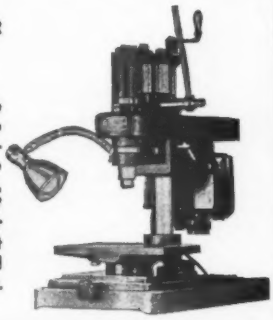

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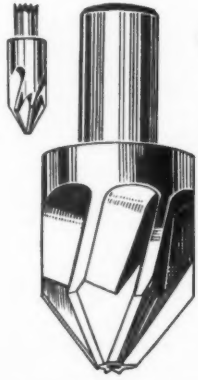

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Bulletin No. 1901 explains and illustrates the lathe's electronically controlled pre-selection of speeds. The 22-page bulletin is available upon request from THE MONARCH TOOL MACHINE CO., Dept. 5-38, Sidney, Ohio, or use INFORM-A-GRAM Key No. 538-T.

A PHOTOGRAPHIC EXHIBIT OF STRENES METAL CASTINGS, contained in a booklet published by the Advance Foundry Co., illustrates ferrous alloy castings which are largely dies employed for almost everything that includes drawing and forming operations. The booklet, available upon request, also shows parts casting. Write to G. A. Kramer, Sales Mgr., THE ADVANCE FOUNDRY CO., Dept. 84, 111 Seminary Ave., Dayton, Ohio, or use INFORM-A-GRAM Key No. B84-T.

A NEW BRUNO KIT, containing an Adjustable Boring Bar Holder and Boring Bar Set, packaged in an attractive new "picture" box, is announced by Bruno Tools. The heavy duty holder secures any type boring bar or drill, reamer and chuck in exact center and can be easily installed on any nine- or ten-inch swing lathe. An exclusive Lever-Lock grip is a feature of the Boring Bar Set which comes in three sizes. Details are available from BRUNO TOOLS, Dept. 19.5, 8330 Santa Monica Blvd., Beverly Hills, Calif., or use INFORM-A-GRAM Key No. K19.5-T.

FLEXIBLE SHAFT MACHINES, HIGH SPEED GRINDERS, tools and accessories are illustrated and described in a folder published by Wyzenbeek and Staff, Inc. Included in the "Wyco" line are Flexible Shaft Machines from ¼ to 2 H.P.; High Speed Grinders from 1/18 to 1 H.P.; sanding drums, brushes, buffs, grinding wheels, cutters and others. Copies of the folder are available from WYZENBEEK & STAFF, INC., Dept. 5-33.5, 838 W. Hubbard St., Chicago 22, Ill., or use INFORM-A-GRAM Key No. 533.5-T.

A NEW LINE OF MECHANICS LENGTH HIGH SPEED DRILLS is now available in fractional sizes from 1/16" to ½" diameter, wire gauge sizes from No. 1 through No. 34. These drills are 15% shorter than equivalent sizes of jobbers length drills, and correspondingly lower in price. Faster feeds and greater strength are among the advantages featured in an illustrated bulletin, RM-1, with complete price and size list. Copies are available from REPUBLIC DRILL AND TOOL CO., Dept. 4-40.5, 322 S. Green St., Chicago 7, Ill., or use INFORM-A-GRAM Key No. 440.5-T.

NOW OFFERING A NEW TOOLING SERVICE with trained engineers who visit plants to observe, recommend and build Special Tools and Dies to overcome difficult manufacturing problems, Andersons, Inc., aim to promote maximum production as they continue producing necessary precision tools and dies. Literature describing their accomplishments is available from ANDERSONS, INC., Dept. 28, 2333 Nelson St., Chicago 18, Ill., or use INFORM-A-GRAM Key No. K28-T.

A COMPLETELY NEW 64-PAGE CATALOG of "Airgrip" chucks, cylinders, and valves has just been issued by Anker-Holth Mfg. Co. Illustrations and descriptions of air and hydraulic chucks, collets, arbors and mandrels, cylinders (rotating and non-rotating), drill press units, valves and lubricating assemblies, as well as information of special features, numerous blueprints and diagrams showing product dimensions and complete specifications on models and sizes. Copies are available on request from ANKER-HOLTH MFG. CO., Dept. 9-52, 2735 Connors St., Port Huron, Mich., or use INFORM-A-GRAM Key No. 952-T.

NEW STEEL, CHROME PLATED, TUNGSTEN CARBIDE, NORBIDE PRECISION GAGES are described and illustrated in a 4-page catalog just released by Sturdy Tool & Gage Co. In addition to producing fine profile, flat plug, built-up and other special gages, Sturdy is specializing in the manufacture of jigs, fixtures and non-cutting tools of new steel, chrome plate, Stellite, tungsten carbide and Norbide. Copies are available upon request from STURDY TOOL & GAGE CO., Dept. 27, 14520 Schaefer Highway, Detroit 27, Mich., or use INFORM-A-GRAM Key No. K27-T.

POST 1947 WEEKLY WALL CALENDAR is being offered free by the Fredrick Post Co. Spiral bound 12" x 20", the calendar-catalog with engineering data and full twelve months on the back has a five-color top portraying the draftsman as master of the future. Fifty-two weekly pages feature standard items, drafting machines and furniture and the introduction of new drafting room merchandise. Send to the FREDRICK POST CO., P. O. Box 803, Dept. 7-97, Chicago, Ill., or use INFORM-A-GRAM Key No. 797-T.

AN INTERNATIONAL STANDARD FOR MEASUREMENT OF HARDNESS OF RUBBER, the A-2 Durometer contains a miniature beam weigher scale and has no sliding parts to contend with. Although results are best when the instrument is mounted on its operating stand it can be used free handed and carried to test pieces not easily moved. Copies of bulletin R-6 will be sent on request from the SHORE INSTRUMENT & MFG. CO., INC., Dept. 1-26, 90-25 Van Wyck Blvd., Jamaica 2, N. Y., or use INFORM-A-GRAM Key No. 126-T.

"FOR LITTLE INSIDE JOBS," Bay State Internal Grinding Wheels are made closely to size with arbor holes parallel to face and accurately centered. They take heavy fast cuts, have consistent duplication and controlled porosity. Literature is available from BAY STATE ABRASIVE PRODUCTS CO., Dept. 2-05, Westboro, Mass., or use INFORM-A-GRAM Key No. 205-T.

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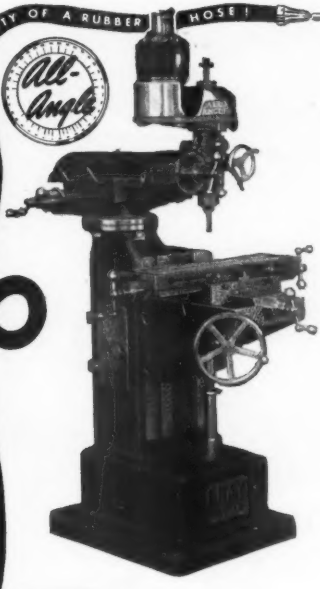

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FREE MACHINING QUALITY is a novel feature of "Speed-Cut", a new die steel produced by Vanadium-Alloys Steel Company. Speed-Cut will machine as readily when hardened to 300 Brinell as other steels used for the same purpose in their annealed state. Die casting dies, formerly used in the annealed condition because of high costs of finishing after treatment, can thus be replaced with a steel of high hardness, better capable of resisting the Brinelling action of chilled metal and other operating hazards. A new bulletin has recently been issued describing "Speed-Cut" steel and giving pertinent information about its composition and heat treatment. Copies will be mailed on request from Vanadium-Alloys Steel Co., Dept. 71, Latrobe, Pa., or use INFORM-A-GRAM Key No. J71-T.

"DRILLS, HOW TO SHARPEN THEM", a Republic Drill & Tool Co. 24-page manual, offers information about proper point grinding and web thinning of drills. Numerous diagrams present right and wrong methods of sharpening. Illustrations and descriptions of correct freehand web thinning and machine pointing of shankless drills will be of great assistance to most users of twist drills. Copies of manual G-1 are available upon request from Republic Drill & Tool Co., Dept. 4-40, 322 South Green St., Chicago 7, Ill., or use INFORM-A-GRAM Key No. 440-T.

VIVID CHANGES OCCURRING DURING A HEAT within the walls of an electric arc furnace now may be seen in actual colors through the eyes of the motion picture camera. Allegheny Ludlum Steel Corporation has produced a 15-minute picture story, "Melting of Huron Die Steel," which graphically reveals what the human eye never has been able to observe—the true color of the molten steel and slag. The film was shot through an open furnace door by a camera set up eight feet away. It is available free of charge, for showing before technical and lay audiences, on request to Allegheny Ludlum Steel Corp., Dept. TD-54, Oliver Bldg., Pittsburgh 25, Pa., or use INFORM-A-GRAM Key No. 678-T.

"HOW TO POUR BEARINGS" is the title of a two-color, illustrated wall card recently published by Joseph T. Ryerson & Son, Inc., manufacturers of Glyco Babbitt Metals. With a series of six cartoon type pictures, the steps necessary to secure good, tightly lined bearings are made clear and easy to follow. The instructions are printed on card stock suitable for hanging in the shop. Write to Joseph T. Ryerson & Son, Inc., Dept. 4-51, 16th & Rockwell Sts., Chicago, Ill., or use INFORM-A-GRAM Key No. 451-T.

APPLICATIONS OF CARBIDE DIES to deep drawing of sheet metal are illustrated and described in a new booklet (No. D-120) issued by Carboloy Company, Inc. An outstanding application cited describes drawing operations involving highly abrasive beryllium copper. Here, Carboloy cemented carbide replaced tool steel at two critical points, the draw ring and the extruding punch. Die and punch life were stepped up 75 times. For copies of booklet No. S-120 write Denham, Dept. 82, 812 Book Bldg., Detroit 26, Mich., or use INFORM-A-GRAM Key No. 82-T.

SHOP AIDS

THE APPLICATION OF RUST-RESISTANT COATINGS to iron and steel, by immersion in an acid phosphate bath, is described in a 113-page handbook now on sale. Written by Lloyd O. Gilbert, U. S. Army Ordnance Department, it was originally prepared for use in rust proofing army ordnance equipment. It now may prove helpful to metal working technicians in setting up and operating phosphating equipment. Orders for the report (Phosphating PB-32864; photostat, $8.00; microfilm, $3.00; 113 pages, including photographs, tables), should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C., and should be accompanied by check or money order payable to the Treasurer of the United States.

QUESTIONS AND ANSWERS relating to grinding problems are contained in a bulletin issued by Dayton Grinding Wheel Division, Simonds Worden White Co. The questions have come from users of grinding equipment and pertain to problems they are encountering in performing difficult jobs. The answers are given by Allen Steel, manager, Dayton Grinding Wheel Division. Turning and Dressing; Balancing; Surface, Centerless, Cylindrical, Internal, Gear, Thread, Tool, and Cutter Grinding; Cutting Off; Cutting Fluids; Safety; and General subjects are discussed. Copies of this bulletin, "101 Grinding Questions Answered", can be secured by writing Simonds Worden White Co., Dept. 37, Dayton 7, Ohio, or use INFORM-A-GRAM Key No. D37-T.

EIGHT LOOSELEAF PAGES, DEVOTED TO THE EXPLANATION and complete photographic and diagrammatic illustration of eight separate job operations, adapting the Bellows Senacon air-powered motors and feeds, hydro-check, and lubro-unit are included in the "Foto Facts File", the first of a new series of case histories being presented by Bellows Senacon Co. Discussing the part, material, operation and machine, this file shows the effective use of air in speeding production. It is available upon request from the Bellows Senacon Co., Dept. 8-39, 798 North Main St., Akron, Ohio, or use INFORM-A-GRAM Key No. 839-T.

"HEAT TREATING ALUMINUM ALLOYS" provides information in a form readily usable by both the non-technical man and the highly trained technician. The what, why and how of heat treating aluminum is simply explained in the first section. A brief tabular form of thermal treatment constitutes the second part. Section three is for the metallurgical and operating personnel. This 144-page book, containing illustrations, tables, photomicrographs and charts is available from Reynolds Metals Co., Dept. 47, 2500 So. Third St., Louisville 1, Ky., at $1.00.

DIFFICULT METAL FORMING OPERATIONS OF STAINLESS STEEL have been solved by the Hydraulic Press Mfg. Co., producers of H-P-M Fastraverse presses. "Deep Drawing and Bulging Stainless Steel", written by J. E. Obernesser, of International Harvester Co., describes this highly developed technique used in the manufacturing of stainless steel dairy equipment. The versatile H-P-M "All-Hydraulic" press has solved many metal forming problems with a single production unit. Write The Hydraulic Press Mfg. Co., Dept. 3-28, Mount Gilead, Ohio, or use INFORM-A-GRAM Key No. 328-T.

FOR USERS OF TWIST DRILLS, Chicago Latrobe Twist Drill Works has recently prepared a chart "Safe Feeds and Speeds for High Speed Drills". Speeds and feeds shown apply to average working conditions and materials with regard to conserving drills and avoiding excessive machine tool wear. This chart, and any other drilling information, is available upon request from Chicago Latrobe Twist Drill Works, Dept. 5-67, 441 West Ontario St., Chicago 10, Ill., or use INFORM-A-GRAM Key No. 567-T.

A SIMPLIFIED CONVEYOR SYSTEM FOR CONVENTIONAL HEAT TREATING, austempering, martempering, flow heat treatment, liquid carburizing, and cycle-annealing, is completely discussed in a mimeographed book "Holden Salt Bath Automatic Conveyor Equipment". A permanent, rigid over-all structure is not required for installation of this conveyor system and many drawings and charts are used to illustrate installations and text. Copies will be sent from the A. F. Holden Co., Dept. 1-50, Metallurgical Engineers, New Haven 8, Conn., or use INFORM-A-GRAM Key No. 150-T.

THE THEORY OF SOLDERING, BRAZING AND LOW TEMPERATURE WELDING is discussed in a pamphlet by Eutectic Welding Co. Soldering and brazing are compared to the new Eutectic process which, with its rods, permits welding at low temperatures, thereby avoiding distortion, stresses and changes in the parent metal. Simple experiments are illustrated, technical data is given as well as the history of "Low Temperature" Welding. Copies are available upon request from Eutectic Welding Alloys Co., Dept. 81, General Offices, 40 Worth St., New York 13, N. Y., or use INFORM-A-GRAM Key No. 81.5-T.

"SIMPLIFIED PUNCH AND DIEMAKING", written by men who designed and produced some of the most effective tools for wartime industry, James Walker and Carl C. Taylor, explains fully and clearly each step in the design, construction and operation of dies and punches. Inclusive, up-to-date and entirely practical, it provides a comprehensive text for tool engineers as well as a complete text for the novice. The book is available for $5.00 from the Macmillan Co., 60 Fifth Ave., New York 11, N. Y.

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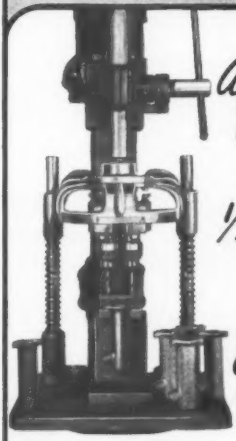

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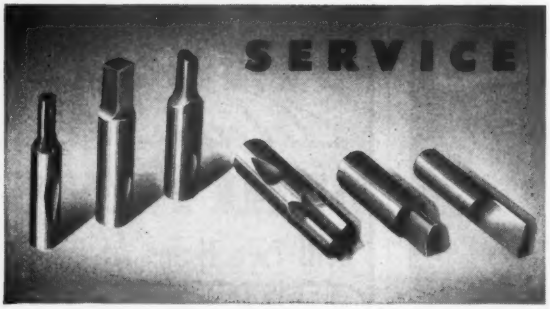

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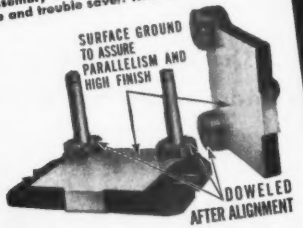

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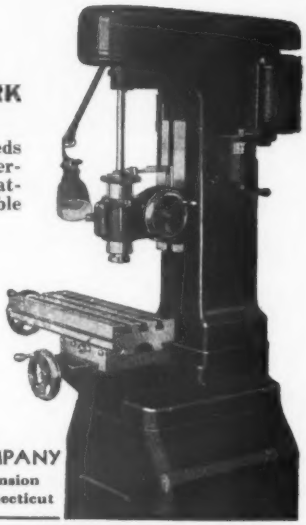

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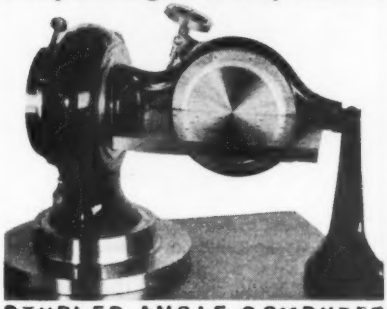

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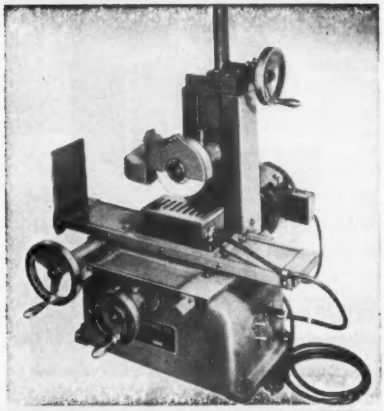

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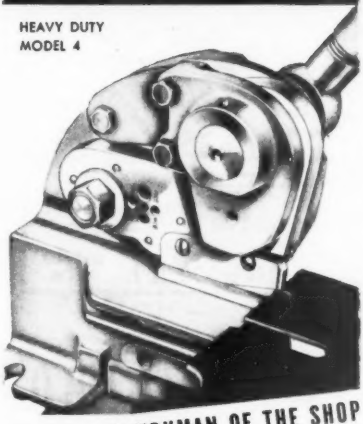

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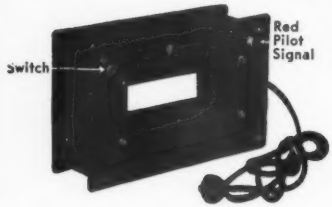

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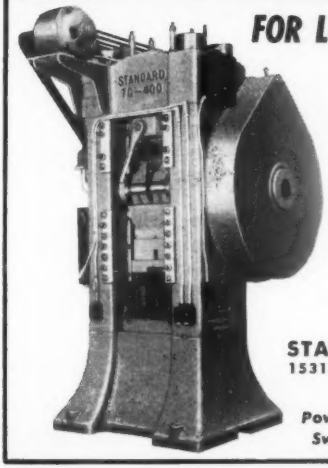

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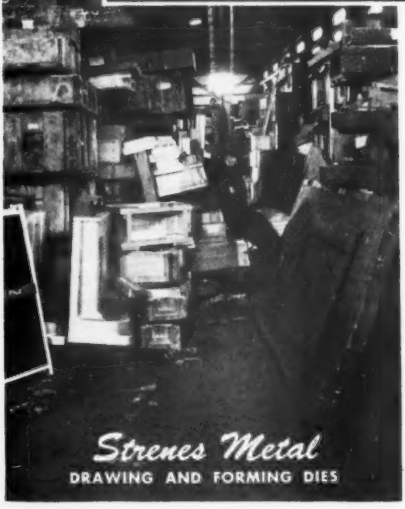

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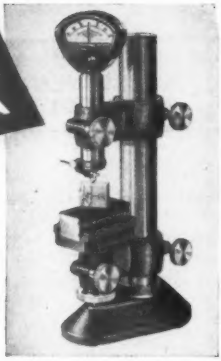

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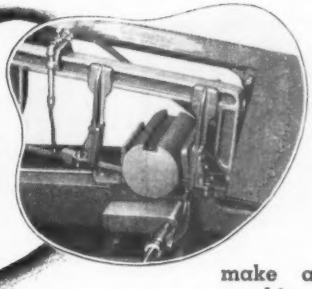

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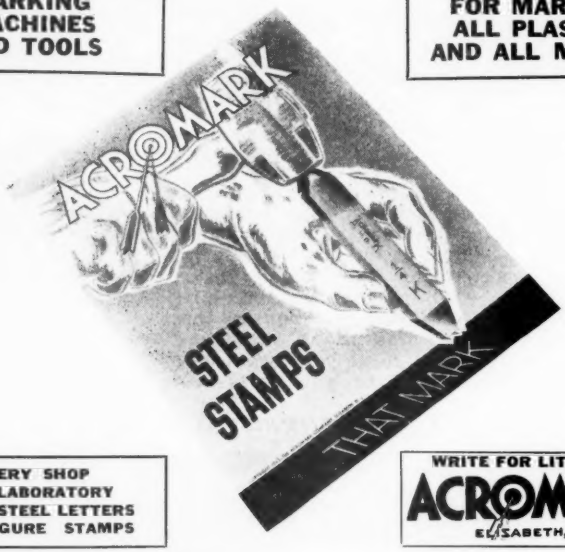

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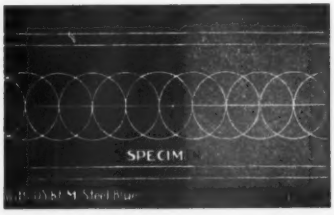

DYKEM STEEL BLUE
STOPS LOSSES
making dies and templates

Simply brush on, ready for the layout in a few minutes. The dark blue background makes the layout lines show up in sharp relief, and at the same time prevents metal glare. Increases efficiency and accuracy.

Write for full information.

THE DYKEM COMPANY
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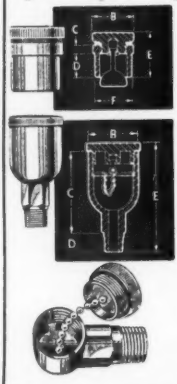
SCREW TOP OILERS
for Vapor-Tight Protection



- Covers Anchored—can't drop or lose
- Tops gasketed for vapor-tight closure.
- Threads are die cut for snug fit.
- Knurled tops for convenient removal.

Styles "RS", "AS", "ASA" and "STG" Oilers, although standard stock items, are somewhat of a specialty. They are particularly adapted for revolving, mixing or agitating equipment—in food processing and similar applications requiring rigid sanitation—also for chemical and other industries having harmful vapors or excessive dust conditions. Available in a range of capacities. Ask for catalog No. 60 presenting complete line of lubricating devices.

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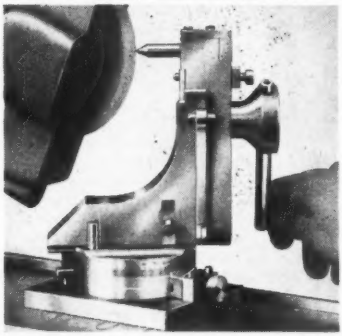
Why EDISON-SPLITDORF CORPORATION prefers "Fluidmotion"* RADII and ANGLE DRESSERS



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BALL-BEARING MOUNTED

FEATURES: .0001" accuracy
Automatic Centering
7" & 14" wheel capacities
"Fluidmotion" dressing
Dustproof, chatterless

*Reg. U. S. Pat. Off.

These prominent manufacturers of high-performance ignition products like "Fluidmotion" because:

1. Consistent accuracy is obtained—*easily* and *simply*.
2. Wheels last longer, since "Fluidmotion" accuracy permits a minimum removal of wheel material at each dressing.
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4. *One continuous motion* dresses both angles and radius, at *one* setting.

"Fluidmotion" Radii and Angle Dressers are earning similar endorsement from users in many industries because they are designed by form-grinding specialists.

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Representatives in Principal Cities

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Now — you can do milling, slotting, grinding, grooving, squaring shafts, sawing at angles, and many other important operations on your lathe. PALMGREN MILLING ATTACHMENT is a necessary fixture for small shops, schools and emergency work in large plants. Fits South Bend, Atlas, Craftsman, Logan, Sheldon and all other makes. It has graduation for rotary angle adjustments, also graduated feed and adjustment screw. Easily mounted by straddling lathe's regular tool post. Try one—it will quickly pay for itself.

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150	1½"	1"	1⅝"	6½	1" Dia	$18.75
250	2½"	1 7/16"	2⅛"	11	1¼" Dia	24.75
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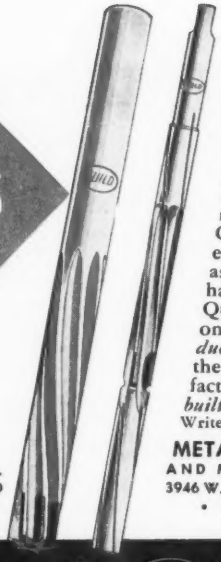

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in sizes from .025 diam.

CARBIDE TIPPED
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● GUILD is the new name for an old established line of reamers whose reputation for accuracy has become outstanding in the manufacture of aircraft—motors—engines—small arms—radios—fine instruments, etc. The name GUILD is stamped on each individual reamer as an identification—a hallmark of finest quality. Quality that is possible only by *creative* and *productive* ability far above the average in the manufacture of *reamers specially built for special purposes.* Write for booklet.

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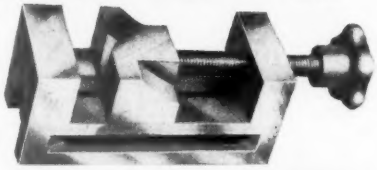
4 Sizes All Priced To Sell



JOSEPH B. FAKES & COMPANY
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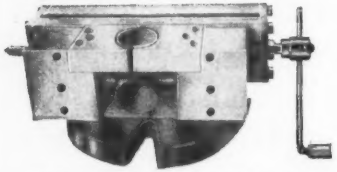
"JOHNS" DRILL JIGS



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Made in 14", 8", 6" sizes

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Motor: ½ HP.
Floor Space: 66" x 31"
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Speeds: 35, 90, 130, 190 feet per minute
Blade: 11' 5" x ¾" x .032"

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The "LOW COST" Johnson Metal Cutting Band Saw is rigidly constructed to withstand years of service ● Dual frames eliminate torsional strain ● Machined bed assures extreme accuracy by most inexperienced operator ● Cuts fast because cutting action is continuous ● Blade never overheats . . . saves on cutting costs.
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Comes in Blue, Black, Orange, Red. Dries fast. Oil resistant. Won't chip, crack or flake off. Also ideal as marking dye. Get 8-oz. brush-in cans, pts., qts., drums. SAMPLE FREE!

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16 Ga., drag holes, handles both ends.

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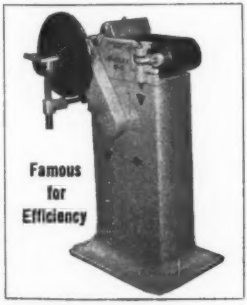

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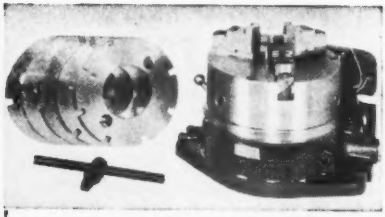

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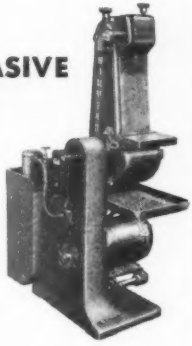

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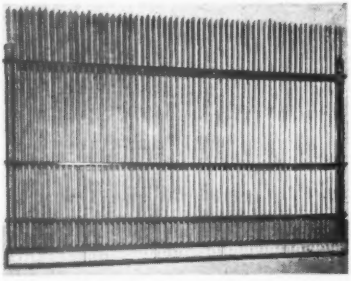

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- Outlast more than 100 steel gage blocks
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✓ **SKID LOAD**

or a

✓ **PALLET LOAD**

You can handle it quickly, easily and cheaply with a

LYON-Raymond
Hydraulic
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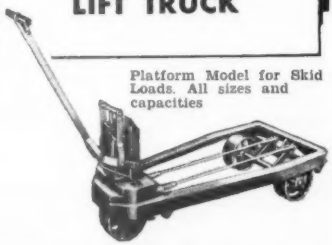

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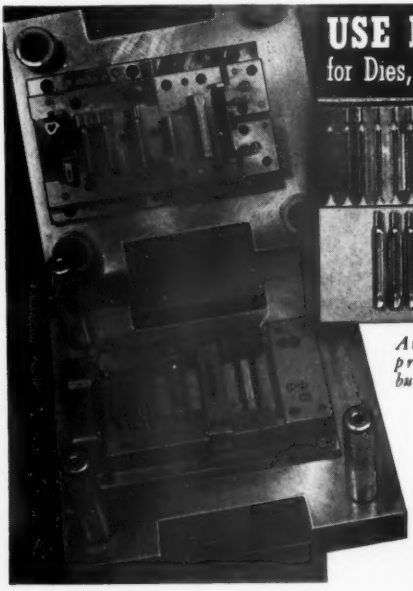
Square, Straight Tapping in Half the Time

The Dahlstrom Tap Guide practically eliminates tap breakage and saves wasted hours getting broken taps out of expensive dies. It does the job in a jiffy with work always straight and true. Just fasten it to a post or bench, slip a Tap Adaptor into the spindle, and even an inexperienced operator can handle it. Equipped with 7 Adaptors, ranging from 8-32 to ½". Taps not furnished. Ask your mill supply house, or $42.50 F. O. B. Minneapolis. *Literature on request.* Dahlstrom Manufacturing Co., 422 South Sixth Street, Minneapolis 15, Minn.

Dahlstrom **TAP GUIDE**



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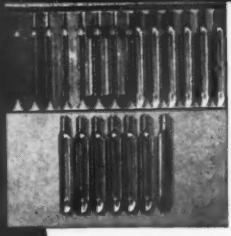
for Dies, Special Tools, Jigs, Fixtures, Molds



An eight-station progressive die built by FEDERAL.

- **FEDERAL** equipment is up-to-the minute.
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- When you have a tooling problem, write FEDERAL.

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- "Open Window" type sliding jaw exposes scale completely and allows a free reading.
- Knife edged hardened jaws accommodate thread measurements.
- Accurate measurements to .001".
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- Painstakingly machined, American made.

Catalog Number	Size	Scale Graduations	Vernier Reading
21	6"	1/40"	.001
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Also AMIC Precision Vernier Calipers, Height Gages, Depth Gages, Pocket Calipers, Precision Graduated Metal Scales.

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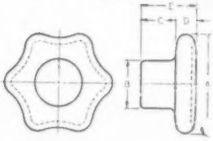

Designed for use in three-jaw chucking.

Part No.	A	B	C	D	E	Price
K-1	2	3/8	5/8	3/8	1	$ .18
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K-3	3	1 3/8	1	1/2	1 1/2	$ .25

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A-1	4	1 1/4	3/8	1 1/4	$ .65
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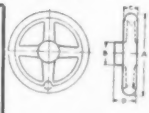
A-3	8	1 3/8	3/8	1 1/2	$1.95
A-4	10	2 1/4	1	2 1/4	$2.65
A-5	12	3	1 1/4	3	$3.80



Design approved by engineers and actual tests.

REQUEST CHARTS FOR FULL INFORMATION WITH YOUR ORDER.

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The knurling on the head of the "Unbrako" Socket Head Cap Screw provides a slip- and fumble-proof grip, even though fingers be ever so oily. And, therefore, it can be screwed in farther and faster, before a wrench must be used.

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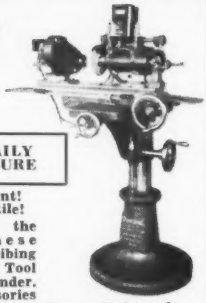

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Shop men "in the know" use these words in describing the Greenfield Tool & Cutter Grinder. Shop-built accessories may be added to make a Universal Grinder that will efficiently handle any grinding operation within its capacity.

Investigate this Tool & Cutter Grinder—you will find that smoother operation, better satisfied workmen and faster production are all possible with a Greenfield in your shop.

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PRODUCTION MACHINE COMPANY

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With the correct ARMSTRONG TOOL HOLDERS for each operation you will be permanently tooled-up for every operation on lathes, planers, slotters and shapers. They are sold by all leading industrial distributors.

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Armstrong Bros. Tool Co.

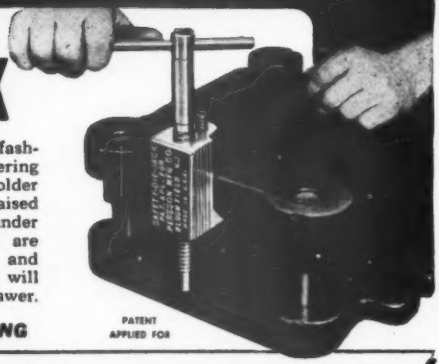
"The Tool Holder People"

340 N. Francisco Ave., Chicago 12 U. S. A.

NOW YOU CAN SEPARATE AND ASSEMBLE DIE SETS..QUICKLY..EASILY..SAFELY!

with a PERSSON

DIE JACK



These Die Jacks eliminate old-fashioned, unsafe, prying or hammering methods. Just clamp on punch holder and turn handle. Punch holder is raised or lowered smoothly, always under control. PERSSON Die Jacks are precision built from fine steel and alloys—a tool every tool maker will want for his tool box or bench drawer.

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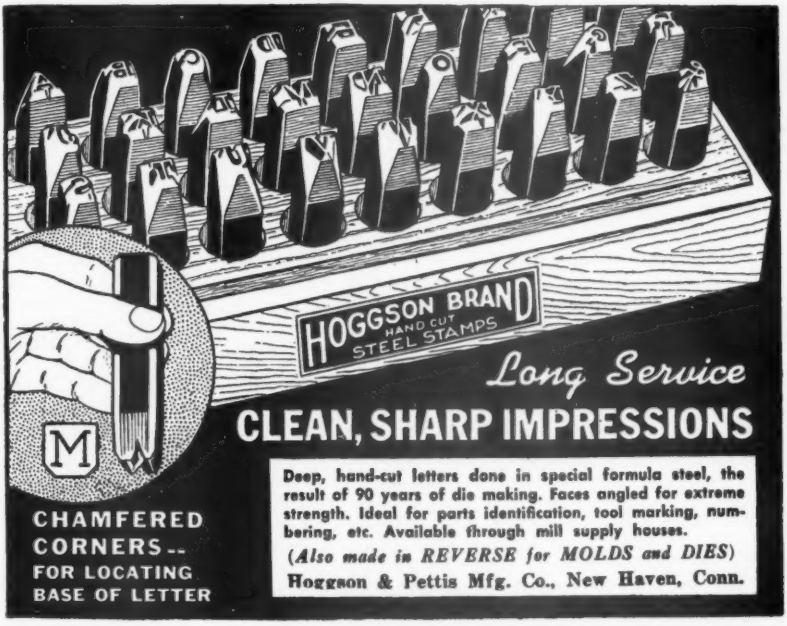

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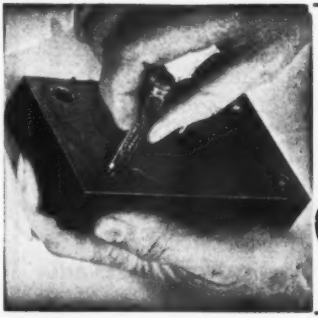

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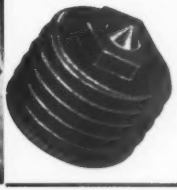

The Heimann Transfer Screw Set is a self-contained, complete tool. No wrenches or pliers are necessary. Made in 3/16″ to 1″ diameters.

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Only from a complete line can you be sure of getting the blades that cut cleanest, fastest, longest on *your* work.

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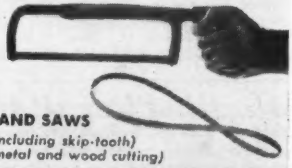

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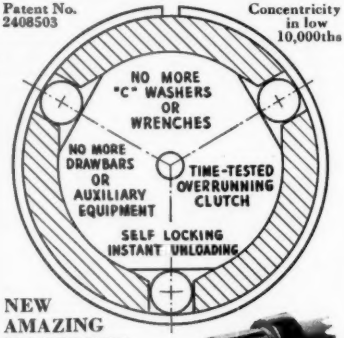
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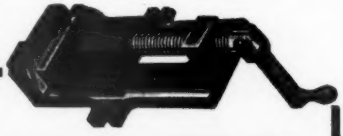

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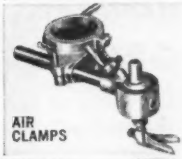

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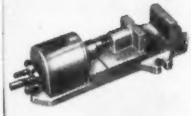

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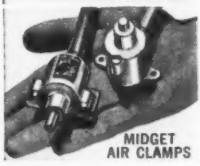

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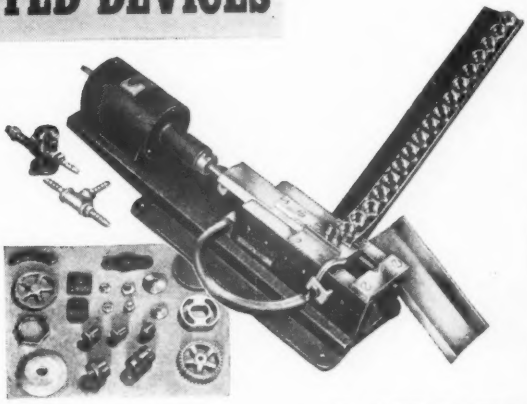

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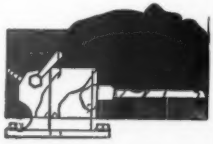

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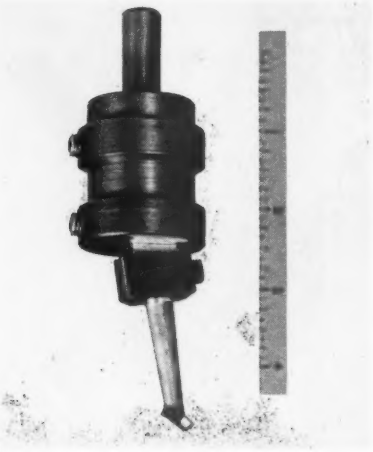

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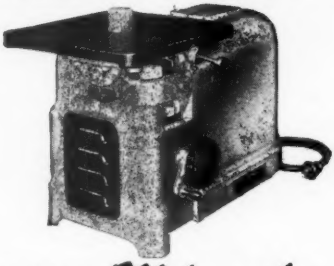

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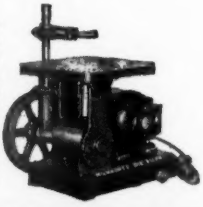

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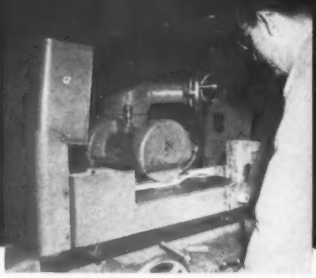

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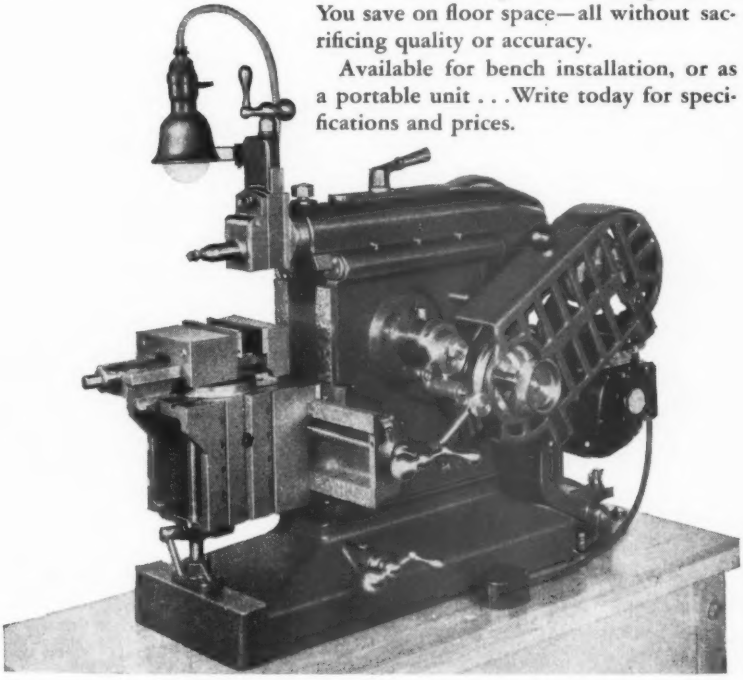

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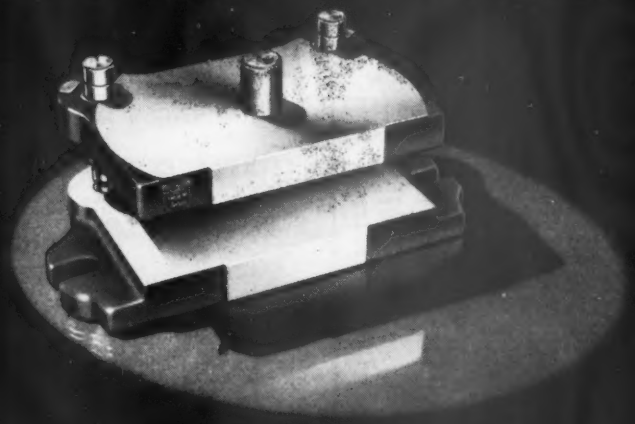

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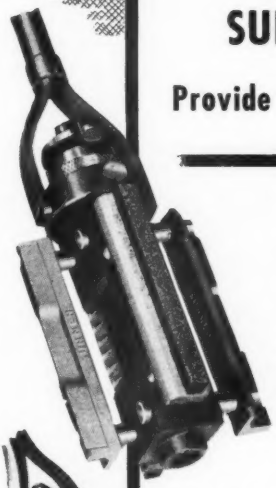
On Cylinders from 2" to 14½" in Diameter

SUNNEN Portable Cylinder Hones

Provide Smooth Accurate Internal Finishes



Standard Model
Range 2 11/16"
to 14½".

Junior Model
Range
2" to 2.6"

These hones provide a fast, easy, practical, economical way to produce internal finishes that are guaranteed to be accurate within .0005". Straight round holes are produced without disturbing previously established alignment. Sunnen Portable Cylinder Hones produce any commercially required finish with full bearing surface. They correct errors of out-of-round, taper, bell-mouth, wavy condition, distortion—and remove tool marks or other surface imperfections.

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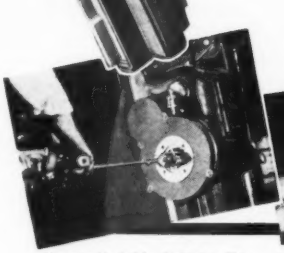
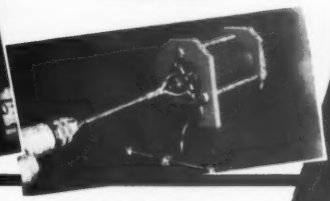
Sunnen Portable Cylinder Hones are ideal for *Selective Fitting of Mating Parts—Small Lot or Odd Size Production—Salvage and Production Repairs—Maintenance of Operating Equipment.*

If you have an internal finishing problem, call a Sunnen Engineer —or write for free bulletin, form No. X-AN5001.

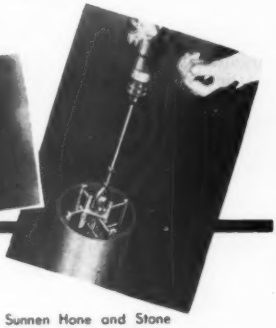
SUNNEN



Sunnen Portable Cylinder Hone saved dismantling this machine to install a new boring bar.



Portable End Clamping Fixture enables part to be honed accurately without distortion.



Sunnen Hone and Stone Support handles large diameter cylinders easily.

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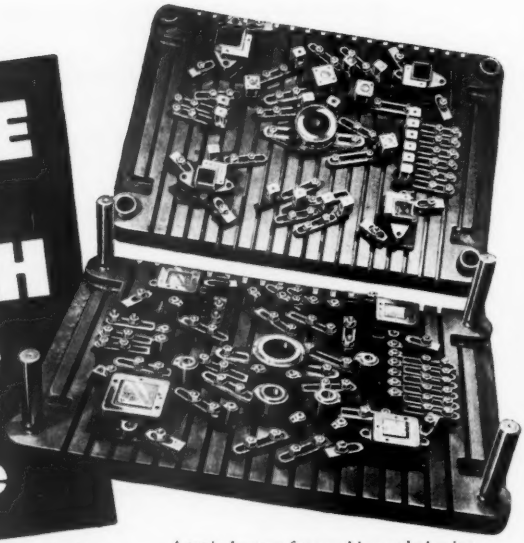
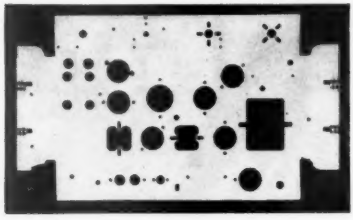
PIERCE and NOTCH at the same time with



A typical set-up for notching and piercing.

Pierced and notched with Whistler multi-use adjustable dies.



WHISTLER MULTI-USE Adjustable Dies

You save press time and speed production by combining corner notching dies and group dies in the same set-up with adjustable piercing dies. Press operations are reduced to a minimum. Engineering changes effecting relocation or sizes of holes can be made without delay right on the press.

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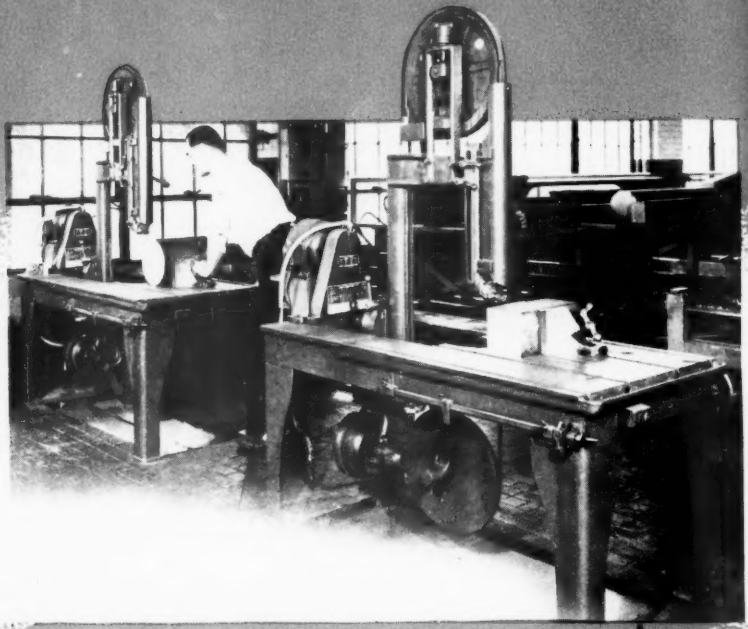

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